REF: 01-DOE-01780; 01-RF-02237; 00654-RF-01; JPF-039-01

Rocky Flats Environmental Technology Site

RECONNAISSANCE LEVEL CHARACTERIZATION/ PRE-DEMOLITION SURVEY REPORT
371 North Side Demolition Project
(Tanks 163, 164, 165, 167, 168 & 169, and Related Containment, Berms and Pads)

371 CLOSURE PROJECT

REVISION 1

September 21, 2001

Reviewed by: ______________________ Date: 9/21/01
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Reviewed by: ______________________ Date: 9/21/01
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Approved by: ______________________ Date: 9-21-01
Jim Floerke, K-H Closure Project Manager

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By J A Naskein
Date 09-21-01 (U/NU)
OK for public release.
ADMIN RECORD
B371-A-000052

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ATTACHMENTS

ABBREVIATIONS/ACRONYMS

ACM	Asbestos containing material
Am	Americium
Be	Beryllium
CDPHE	Colorado Department of Public Health and the Environment
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
COC	Chain of custody
$DCGL_{EMC}$	Derived Concentration Guideline Level – elevated measurement comparison
$DCGL_W$	Derived Concentration Guideline Level – Wilcoxon Rank Sum Test
D&D	Decontamination and Decommissioning
DDCP	Decontamination and Decommissioning Characterization Protocol
DOE	U.S. Department of Energy
DPP	Decommissioning Program Plan
DQA	Data quality assessment
DQOs	Data quality objectives
EPA	U.S. Environmental Protection Agency
K-H	Kaiser-Hill
LBP	Lead-based paint
LCS	Laboratory control sample
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MDL	Minimum detectable limit
MS	Matrix spike
MSD	Matrix spike duplicate
MSDS	Material Safety Data Sheet
OSHA	Occupational Safety and Health Administration
PCBs	Polychlorinated Biphenyls
PDS	Pre-Demolition Survey
PDSP	Pre-Demolition survey Plan
Pu	Plutonium
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RFCA	Rocky Flats Cleanup Agreement
RFETS	Rocky Flats Environmental Technology Site
RFFO	Rocky Flats Field Office
RLC	Reconnaissance Level Characterization
RLCR	Reconnaissance Level Characterization Report
RSA	Removable Surface Activity
RSP	Radiological Safety Practices
SVOCs	Semi-volatile organic compounds
TSA	Total surface activity
U	Uranium
V&V	Verification and validation
VOCs	Volatile organic compounds

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EXECUTIVE SUMMARY

A combined Reconnaissance Level Characterization (RLC) and Pre-Demolition Survey (PDS) was performed to "release" Tanks 163, 164, 165, 167 168 and 169, and to "type and release" the tank containment, berms and pads. These tanks were previously characterized in the *Reconnaissance Level Characterization Report, Building 371 Cluster*, Revision 1, August 28, 2000, but the characterization did not meet the PDS requirements for release. These facilities and structures are part of the scope of work for the 371 North Side Demolition Project.

This characterization encompassed radiological and chemical characterization pursuant to the D&D Characterization Protocol (MAN-077-DDCP) and the Pre-Demolition Survey Plan for D&D Facilities (MAN-127-PDSP). Results indicate that no radiological contamination exists in excess of the prescribed release limits of DOE Order 5400.5. Potassium hydroxide (KOH) salts remain in Tanks 168 and 169. The KOH salts will be removed by triple rinsing with steam and water prior to the start of decommissioning, and pH measurements will be taken to verify that the tanks do not exhibit hazardous waste characteristics. Friable asbestos exists on top of Tanks 168 and 169 in the form of a gray mud compound used for insulation. The asbestos will be removed and disposed of in compliance with Environmental Protection Agency (EPA) and Colorado Department of Public Health and Environment (CDPHE) regulations. No radiological or chemical hazards are present under the tank containment, berms and pads, based on the Soil Disturbance Approval Form and associated documentation (May 2001).

Based on the absence of radiological and chemical hazards, Tanks 163, 164, 165 and 167 are confirmed to be free of contamination and can be released. Once Tanks 168 and 169 are verified to be empty and free of hazardous waste characteristics, they can be confirmed as free of contamination and released. The tank pads, the containment for Tanks 163 and 164, and the berms for Tanks 167, 168 and 169 are also free of contamination, are designated as Type 1 structures, and can be released as well. This designation is subject to concurrence by CDPHE.

To ensure that the facilities and structures remain free of contamination and that RLC/PDS data remain valid, isolation controls will be established and posted accordingly. Demolition shall not occur until the RLC/PDS Report is submitted, and concurrence and approval is received.

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1 INTRODUCTION

A combined Reconnaissance Level Characterization (RLC) and Pre-Demolition Survey (PDS) was performed to enable compliant disposition and waste management of facilities and structures that are part of the 371 North Side Demolition Project. The facilities and structures included in this RLC/PDS are Tanks 163, 164, 165, 167, 168 and 169; and tank containment, berms and pads. They no longer support the RFETS mission and need to be removed to reduce Site infrastructure, risks and/or operating costs. The locations of these structures are shown in Attachment A.

This document presents the RLC/PDS results. The RLC/PDS was conducted pursuant to the Decontamination and Decommissioning Characterization Protocol (MAN-077-DDCP) and the Pre-Demolition Survey Plan for D&D Facilities (MAN-127-PDSP). The RLC/PDS built upon physical, chemical and radiological hazards identified in the *Reconnaissance Level Characterization Report, Building 371 Cluster*, Revision 1, August 28, 2000. This RLCR included the six tanks addressed in this RLC/PDS Report but did not include the tank pads, berms and containment. Also, the characterization on the tanks was not designed to meet release criteria and make release decisions pursuant to the PDSP. In addition, the original RLCR included three additional facilities which are included within the 371 North Side Demolition Project – B373, B377 and B378. These facilities were characterized pursuant to the PDSP and are awaiting demolition.

1.1 Purpose

The purpose of this report is to communicate and document the results of the RLC/PDS efforts. RLCs are performed to identify radiological, chemical and physical hazards and to type facilities pursuant to the Decommissioning Program Plan (DPP). PDSs are performed before building demolition to define the final radiological and chemical conditions of a facility. Final conditions are compared with the release limits for radiological and non-radiological contaminants. RLC/PDS results will enable project personnel to make final disposition decisions, develop related worker health and safety controls, and estimate waste volumes by waste types.

1.2 Scope

This report presents the final radiological and chemical conditions of the 371 North Side Demolition Project facilities and structures. However, a PDS was previously conducted on Buildings 373, 377 and 378 (refer to *Reconnaissance Level Characterization Report, Building 371 Cluster*, Revision 1, August 28, 2000), and therefore, these buildings were not characterized as part of this RLC/PDS. Also, environmental media surrounding the structures were not sampled based on the Soil Disturbance Approval Form and associated documentation (May 2001).

1.3 Data Quality Objectives

The Data Quality Objectives (DQOs) used in designing this RLC/PDS are consistent with those defined in the Pre-Demolition Survey Plan for D&D Facilities (MAN-127-PDSP). Refer to Section 2.0 of MAN-127-PDSP for these DQOs.

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2 RECONNAISSANCE LEVEL CHARACTERIZATION

During FY00, an initial Reconnaissance Level Characterization (RLC) was conducted to understand the 371 Cluster history and related hazards. The RLC included the six tanks included in this RLC/PDS. The RLC consisted of facility walkdowns, interviews, document review, including review of the Historical Release Report, radiological surveys, and chemical sampling and analysis. Chemical products were identified, as well as one elevated radiological measurement on Tank 168 piping. The elevated measurement was believed to be due to polonium, which was to be confirmed as part of this RLC/PDS. Results, which were used to help plan the RLC/PDS, are documented in the *Reconnaissance Level Characterization Report, Building 371 Cluster*, Revision 1, August 28, 2000.

3 RADIOLOGICAL CHARACTERIZATION AND HAZARDS

The 371 North Side Demolition Project facilities and structures were characterized to confirm that the structures meet unrestricted release criteria per the PDSP. Section 3.1 describes the radiological characterization process that was performed, and Section 3.2 summarizes the radiological hazards that were identified, if any.

3.1 Radiological Characterization

Pre-demolition survey packages were designed and assembled in accordance with the PDSP and PRO-475-RSP-16.01, *Radiological Survey/Sampling Package Design, Preparation, Control, Implementation and Closure*. This resulted in four Survey Units (SU):

SU#	Description
371002	Product Water Tanks #163 and 164.
371003	Secondary containment and pads for Product Water Tanks #163 and 164.
371004	Tank 165 (concrete silo), Tank 167 (nitric acid), and Tanks 168 & 169 (potassium hydroxide).
371005	Secondary containment and pads for Tanks 165, 167, 168 & 169.

The Radiological Characterization Package is presented in Attachment B. Because elevated alpha activity was found on Tank 168 during RLC, the tank was classified as a Type 2 facility in the original RLCR. However, due to the elevated measurement's location and physical conditions, there was a high probability that the elevated activity was due to polonium, a radon decay product. Therefore the survey design for all survey units was based on requirements for MARSSIM Class 3 areas.

Surveys were performed in accordance with the PDSP and PRO-476-RSP-16.02, *Pre-Demolition (Final Status) Radiological Surveys of Surfaces and Structures*. A total of 60 radiological measurements were collected (i.e., 15 within each Survey Unit), and a 3% surface scan of the total surface area of each Survey Unit was performed. A summary of the radiological survey results is outlined in the Table 3-1 below.

Radiological survey data, statistical analysis results, and survey locations are presented in Attachment C, Radiological Data Summaries and Survey Maps. Radiological survey unit

packages are maintained in the 371 North Side Demolition Project files. Radiological survey data were verified, validated and evaluated in accordance with RSP 16.04, *Radiological Survey/Sample Data Analysis*. Quality Control measures were implemented thorough the survey and sampling process in accordance with RSP 16.05, *Radiological Survey/Sample Quality Control.*

Table 3-1 Summary of Radiological Survey Data

371 North Side Demolition Project	Number of Survey Locations	Removable Activity (RA)				Total Surface Activity (TSA)			
		Alpha (dpm/100 cm^2)		Beta (dpm/100 cm^2)		Alpha (dpm/100 cm^2)		Beta (dpm/100 cm^2)	
		$DCGL_W$ = 20		$DCGL_W$ = 1000		$DCGL_W$ = 100		$DCGL_W$ = 5000	
		Min.	Max	Min.	Max.	Min.	Max	Min.	Max
371002	15	-1.8	2.7	4.8	38.8	-13.3	95.3	-369.1	879.2
371003	15	-1.8	2.4	50.8	202.8	-15.1	42.7	-441.6	1008.1
371004	15	-0.3	12.1	81.2	205.2	-18.6	85.6	148.3	735.0
371005	15	-1.2	5.8	85.2	191.2	7.2	126.5	-304.9	1038.4

Five locations within the three Survey Units exhibited alpha TSA readings near or above the transuranic $DCGL_W$. These elevated readings resulted from a variety of methods, including random TSAs, scans, and Reconnaissance Level Characterization data.

A substantial variability in the alpha TSA measurements was observed over time, indicating the presence of short-lived radon daughters. Three of the five elevated locations were sealed to allow the short-lived radon daughters to decay away. Two of the locations no longer contained enough radioactivity to be statistically viable for radon daughter decay. Also a matching location was selected for each of the five elevated measurement locations. The matching location was of the same material, was on the same equipment, was near the original measurement location, and had a higher than average alpha TSA reading. All of the locations selected for decay were carefully and completely marked to ensure the instrument detector would be placed in precisely the same location for pre-decay and post decay readings. The original and matching locations were sealed for 19 hours and then reevaluated for alpha TSA.

All but one of the locations showed some decrease in alpha activity, with several locations dropping a large percentage of their value. The average decrease in alpha activity was 17.5%. All of the previously elevated locations produced an alpha TSA measurement below the applicable $DCGL_w$ of 100 dpm/100cm^2, and therefore, all four Survey Units meet the unrestricted release requirements of the PDSP. Numerical results are presented in Table 3-2 below.

In addition, no radiological contamination and related hazards are present under the tank containment, berms and pads, based on the Soil Disturbance Approval Form and associated documentation (May 2001).

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Table 3-2 TSA Measurements for Elevated Locations

Location Code & Description	Initial Measurement (dpm/100cm^2)	9/18/01 Measurement (dpm/100cm^2)	Pre-Decay Measurement (dpm/100cm^2)	Post-Decay Measurement (dpm/100cm^2)
371004-RLCR Tank 168, south side	225.0	47.8	55.8	55.1
371004-RLCRa Tank 168, SE side			92.4	88.5
371005-02 Pipe support in 167 berm	126.5	74.6	62.2	40.1
371005-02a Pipe support in 168 berm			77.3	94.9
371005-11 west side of berm	108.1	50.4		
371005-11a west side of berm			92.4	67.5
371004-scan Tank 167 (nitric)	154.0	24.1		
371004-scan-a Tank 167 (nitric)			95.5	91.7
371002-03 Tank 164 footing, SW side	95.3	98.2	86.4	51.9
371002-03a Tank 164 footing, west side			147.1	94.9

NOTE: Matching locations are indicated by an "a" at the end of the location code.

3.2 Radiological Hazards Summary

The RLC/PDS confirmed that Tanks 163, 164, 165, 167, 168, 169 and their associated secondary containments and support pads do not contain radiological contamination above the surface contamination guidelines provided in DOE Order 5400.5 and the RFETS Radiological Control Manual. Isolation control postings will be displayed on the structure to ensure no radioactive materials are introduced.

4 CHEMICAL CHARACTERIZATION AND HAZARDS

The 371 North Side Demolition Project facilities and structures were characterized for chemical hazards per the PDSP. Section 4.1 describes the chemical characterization process that was performed, and Section 4.2 summarizes the chemical hazards that were identified, if any.

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4.1 Chemical Characterization

The chemical characterization process began with a review of RLCR, historical and process knowledge, visual inspections, and PDSP DQOs. The objective was to identify the needs for additional data for use in applying the DQO process. No data gaps were identified (see below), and therefore, no additional data collection was required (refer to Attachment B, Chemical Characterization Package, 371 North Side Demolition Project, Revision 0, August 24, 2001).

4.1.1 Asbestos

An asbestos inspection of the 371 North Side Demolition Project structure was previously performed by a CDPHE-certified asbestos inspector. Suspect asbestos containing material was sampled and analyzed. Results are provided in the Asbestos Inspection Report, July 6, 2000, for the 371 Cluster, prepared by Foothills Environmental . No additional data gaps were identified, and therefore, no additional characterization was conducted during this PDS.

4.1.2 Beryllium (Be)

Based on process knowledge and personnel interviews, there is no reasonable likelihood for Be to be present. Therefore, no Be sampling and analysis was conducted.

4.1.3 RCRA/CERCLA Constituents [including metals and volatile and semi-volatile organic compounds (VOCs & SVOCs)]

Existing historical and process information is sufficient to characterize the tanks and associated containment, berms and pads. Tanks 163 and 164 were never used (i.e., never held any hazardous substances or waste). Tank 165 only contained dry cement, which is not a hazardous substance or waste. Tank 167 stored nitric acid, and it has been confirmed and documented that all the nitric acid has been removed. Tanks 168 and 169 stored potassium hydroxide (KOH), however the KOH has been removed. Some KOH salts remain on the tank sides and bottoms. Also, project files, including Material Safety Data Sheets (MSDSs), indicate that no lead-based paints were used. In addition, there are no records indicating historical spills or releases, and based on facility walk-downs, there is no visual evidence of spills/releases (e.g., no staining) within the tank containment/berms. Furthermore, no chemical hazards are present under the tank containment, berms and pads, based on the Soil Disturbance Approval Form and associated documentation (May 2001). Therefore, no sampling for RCRA/CERCLA constituents was needed or conducted for characterization.

4.1.4 Polychlorinated Biphenyls (PCBs)

Based on process knowledge, there is no reasonable likelihood for PCBs to have been used for tank operations (e.g., in equipment). Also, no PCB hazards are present under the tanks based on the Soil Disturbance Approval Form and associated documentation (May 2001). Therefore, no PCB sampling and analysis was conducted.

Project files indicate that paints containing PCBs were not applied to any of the painted surfaces on the North Side tanks and their containments and pads. MSDSs for paints used on tanks, structural metal, walkways, and the concrete containment for Tanks 163

and 164 do not indicate the presence of PCBs. In addition, PCBs were added to commercial paints in the 1950 – 1960 time frame (Federal Register, Vol. 64, No. 237, dated 12/10/00). Given that the construction and painting of internal and external structures within the 371 Cluster did not occur until the late 1970s, it is unlikely that near 20-year old paint would have been used.

4.2 Chemical Hazards Summary

4.2.1 Asbestos

Friable asbestos exists on top of Tanks 168 and 169 in the form of a gray mud compound used for insulation. This asbestos will be removed and disposed of in compliance with Environmental Protection Agency (EPA) and Colorado Department of Public Health and Environment (CDPHE) regulations. No other asbestos containing material is present on or around the tanks.

4.2.2 Beryllium

Based on process knowledge and personnel interviews (RLC), there is no reasonable likelihood for Be to be present.

4.2.3 RCRA/CERCLA Constituents

Prior to the start of decommissioning, the three Type 2 tanks within the project area (Tanks 167 – 169) will be verified as free of hazards and hazardous waste characteristics. Tank 167 stored nitric acid and was classified as a Type 2 facility in the original RLCR. However, all nitric acid has since been removed. The tank has also been verified as empty through visual inspection and photographs. Tanks 168 and 169 stored potassium hydroxide (KOH) and were classified as Type 2 facilities in the original RLCR. However, the KOH has since been removed from both tanks. Some KOH salts remain on the sides and bottoms of the tanks, but the salts will be removed by triple rinsing with steam and water. The third rinsate will be measured for pH to verify that the tanks do not exhibit hazardous waste characteristic. In addition, none of the tanks contain lead-based paints. Verification that all three tanks are empty and free of hazards and hazardous waste characteristics will be documented in the Project Close-out Report. This report will be placed in the Project files and become part of the CERCLA Administrative Record.

No other hazardous substances or wastes, including lead-based paints, are present in the Project area. There are also no records or visual evidence of chemical spills/releases on the tank pads and in the tank containment and berms. In addition, no chemical hazards are present under the tank containment, berms and pads, based on the Soil Disturbance Approval Form and associated documentation (May 2001).

4.2.4 PCBs

Based on process knowledge and personnel interviews (RLC), there are no hazards associated with any historical PCB use or spills. In addition, project records (e.g., MSDSs) indicate that paints applied to the tanks and their containment and pads did not contain PCBs.

5 PHYSICAL HAZARDS

Physical hazards associated with the 371 North Side Demolition Project consist of those common to standard industrial environments and include hazards associated with energized systems, utilities, height, and trips and falls. Physical hazards are controlled by the Site Occupational Safety and Industrial Hygiene Program, which is based on OSHA regulations, DOE orders, and standard industry practices. .

6 DATA QUALITY ASSESSMENT

Data used in making management decisions for decommissioning of the 371 North Side Demolition Project facilities and structures, and consequent waste management, are of adequate quality to support the decisions documented in this report. The data presented in this report (Attachments A – C) were verified and validated relative to DOE quality requirements, applicable EPA guidance, and original DQOs of the project.

Adequate data quality for decision-making is required by the Kaiser-Hill Team Quality Assurance Program (K-H, 1997, §7.1.4 and 7.2.2), the DOE (Order O 414.1A, Quality Assurance, §4.b.(2)(b)), and the Regulators (EPA Region VIII and the CDPHE). The data and consequent environmental decisions must be technically and legally defensible. Verification and validation (V&V) of the data, in concert with the DQO process, ensure that data used in decisions resulting from the PDS are usable and defensible.

V&V of the data are the primary components of the DQA, and are detailed in the 371 North-Side Demolition Project Characterization Project files under the file header "DQA". A summary of the decisions and uncertainties resulting from the DQO process specific to this project is displayed in Attachment D, Tables D-2. DQA for radiological data drew heavily from guidance provided in the MARSSIM (NUREG-1575) and Radiological Safety Practices (RSPs) 16.04 and 16.05. Other applicable guidance and requirements documents are referenced within the Characterization Project files.

In summary, the V&V process corroborates that the following elements of the characterization process are adequate:

- the *number* of samples and surveys;
- the *types* of samples and surveys;
- the sampling/survey process, in the field; and,
- the laboratory analytical process, relative to accuracy and precision considerations.

7 CONCLUSIONS

The RLC/PDS of the 371 North Side Demolition Project facilities and structures was performed in accordance with the DDCP and PDSP. All PDSP DQOs were met, and all data satisfied the PDSP DQA criteria. Tanks 163, 164, 165 and 167 do not present any radiological or chemical hazards, and Tanks 168 and 169 will be free of hazards once they are verified as emptied and rinsed. The tank containment, berms and pads also do not present any radiological or chemical hazards. Therefore, the tank pads, the containment for Tanks 163 and 164, and the berms for Tanks 167, 168 and 169 are designated as Type 1 facilities, subject to concurrence by CDPHE. Asbestos containing

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material will be removed and disposed of in compliance with EPA and CDPHE regulations. To ensure that the facilities and structures remain free of contamination and that PDS data remain valid, isolation controls will be established, and the facilities and structures will be posted accordingly.

8 REFERENCES

DOE/RFFO, CDPHE, EPA, 1996. Rocky Flats Cleanup Agreement (RFCA), July 19, 1996.

DOE Order 5400.5, "Radiation Protection of the Public and the Environment."

DOE Order 414.1A, "Quality Assurance."

EPA, 1994. "The Data Quality Objective Process," EPA QA/G-4.

EPA, 1998. "Guidance for Data Quality Assessment," EPA QA/G-9.

K-H, 1997. "Kaiser-Hill Team Quality Assurance Program", Rev. 5, December, 1997.

K-H, 1999. Decontamination and Decommissioning Characterization Protocol, MAN-077-DDCP, Rev. 1, June 19, 2000.

K-H, 2000. Pre-Demolition Survey Plan, MAN-127-PDSP, Rev. 0, March 26, 2001.

K-H, 2000, Reconnaissance Level Characterization Report, Building 371 Cluster, Revision 1, August 28, 2000

MARSSIM - Multi-Agency Radiation Survey and Site Investigation Manual, December 1997 (NUREG-1575, EPA 402-R-97-016).

PRO-475-RSP-16.01, Radiological Survey/Sampling Package Design, Preparation, Control, Implementation, and Closure, September 30, 1999.

PRO-476-RSP-16.02, Radiological Surveys of Surfaces and Structures, September 30, 1999.

PRO-478-RSP-16.04, Radiological Survey/Sample Data Analysis, September 30,1999.

PRO-479-RSP-16.05, Radiological Survey/Sample Quality Control, September, 30, 1999

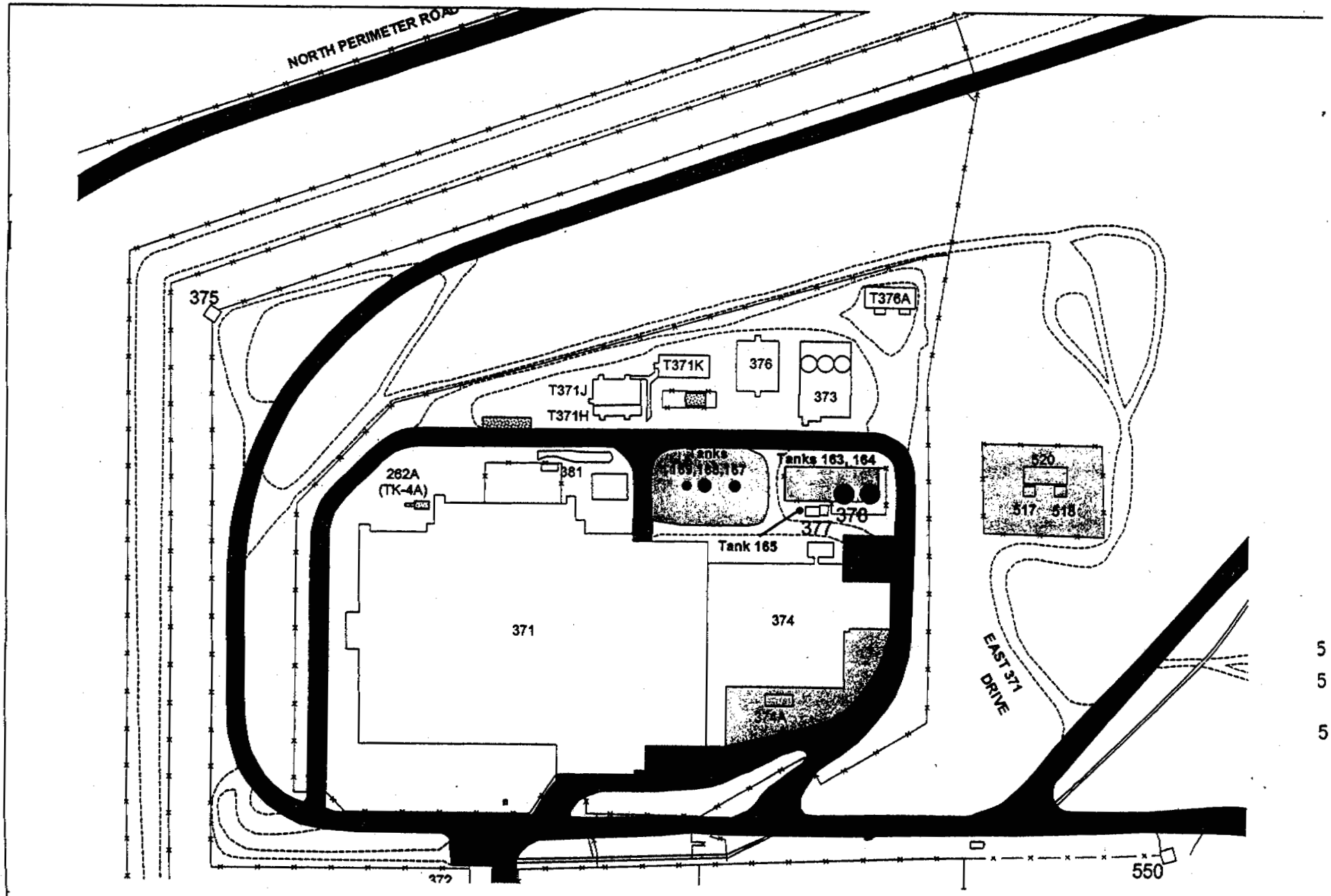
PRO-563-ACPR, Asbestos Characterization Procedure, Revision 0

RFETS, Environmental Waste Compliance Guidance #25, Management of Polychlorinated Biphenyls (PCBs) in Paint and Other Bulk Product Waste During Facility Disposition.

RFETS, Environmental Waste Compliance Guidance #27, Lead-Based Paint (LBP) and Lead-Based Paint Debris Disposal.

ATTACHMENT A

Facility Location Map


NORTH PERIMETER ROAD
375
T376A
T371K
T371J
T371H
376
373
262A
(TK-4A)
381
Tanks 163, 164
376
377
Tank 165
520
517
518
371
374
EAST 371 DRIVE
550

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ATTACHMENT B

Radiological and Chemical Characterization Packages

Rocky Flats Environmental Technology Site

RADIOLOGICAL CHARACTERIZATION PLAN (PACKAGE)

371 NORTH SIDE DEMOLITION PROJECT

(Tanks 163, 164, 165, 167, 168, 169, and Related Containments, Berms, and Pads.)

REVISION 0

August 24, 2001

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PDS Radiological Characterization Plan (Package)
371 North Side Demolition Project
(Tanks 163, 164, 165, 167, 168, 169, & associated secondary containments and tank pads)

* This characterization package was prepared in accordance with MAN-077-DDCP, D&D Characterization Protocol, and MAN-127-PDSP, the Pre-Demolition Survey Plan for D Facilities, latest versions.

* PDSP Data Quality Objectives were used to develop this characterization package.

* Some tank characterization data of Tanks 163, 164, 165, 167, 168, & 169 already exists, only PDS data gaps are specified in this characterization plan. The PDSR will report existing data and newly acquired PDS data.

* It is assumed that some oxidized metalic surfaces as well as areas where rain water may be trapped in MARSSIM Class 3 PDS survey areas will have accumulated detectable levels of Radon produced Po^{210}. Therefore, surface media sampling will be considered during the PDS for any elevated readings encountered where the material exhibits a high probability for capturing Po^{210}.

Instructions:

1. Verify characterization activities are on the Plan-of-the-Day (POD).
2. Perform a Pre-Evolution Brief and/or Job Task Brief in accordance with the Site Conduct of Operations Manual.
3. Verify personnel have appropriate training for the applicable tasks they will be performing.
4. Comply with RWP requirements, if applicable.
5. Comply with facility PPE requirements, as applicable.
6. Inform the Facility Manager, or designee, prior to starting characterization activities.

WARNING

Confined space entry is NOT authorized during the performance of this plan (package).

7. Follow applicable characterization and sampling procedures.
8. Notify Wackenhut Security (x2444) and the Shift Supervisor (x2914), and verify appropriate safety precautions/requirements are followed prior to accessing facility roofs.
9. Coordination with the Environmental Restoration Program organization may be required to further characterize underneath facility foundations and slabs prior to removal.
10. Collect and maintain all characterization paperwork in the Project File(s).
11. All radiological surveys shall be conducted in accordance with the sampling and instruction forms included in 865 North Side Demolition Survey Area Packages. Measurer locations are denoted on maps attached to each survey area package.

PDS Radiological Characterization Plan (Package)
371 North Side Demolition Project
(Tanks 163, 164, 165, 167, 168, 169, & associated secondary containments and tank pads)

Non-Contamination Areas, Buffer Areas, and RMAs

Survey Area	Description	Tank Total Surface Area (m^2)	Scan Area (m^2)	No. of TSAs	No. of Smears	No. of Media Samples
371002	Tanks 163 & 164	926	28	30	30	N/A
371003	T163/164 Secondary Containment & Tank Pads	598	18	30	30	N/A
371004	Tanks 165, 167, 168, 169.	547	16	30	30	2
371005	T167/168/169 Secondary Containments & Tank Pads	536	16	30	30	3
	Totals	2607	78	120	120	5

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PDS Radiological Characterization Plan (Package)
371 North Side Demolition Project
(Tanks 163, 164, 165, 167, 168, 169, & associated secondary containments and tank pads)

Contamination Areas and Fixed Contamination Areas

Survey Area	Description	Floor m^2	Scan m^2	TSA	Smears	Media
N/A	None					
	Totals	0	0	0	0	0

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Rocky Flats Environmental Technology Site

CHEMICAL CHARACTERIZATION PLAN (PACKAGE)

371 NORTH SIDE DEMOLITION PROJECT

(Tanks 163, 164, 165, 167, 168 & 169, and Related Containment, Berms and Pads)

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CHEMICAL CHARACTERIZATION PACKAGE

BUILDING(s): 371 NORTH SIDE DEMOLITION PROJECT (Tanks 163, 164, 165, 167, 168 & 169, and Related Containment, Berms and Pads)

- B373, B377 and B378 are also part of the North Side Demolition Project. These buildings underwent a Pre-Demolition Survey (PDS), and no contamination was found [refer to Reconnaissance Level Characterization Report (RLCR), Building 371 Cluster, Revision 1, August 28, 2000]. Based on the PDS, the buildings were designated as Type 1 facilities. Therefore, no additional characterization is required for unrestricted release.
- Conduit bridges, and below-grade conduit, piping and footings are also part of the North Side Demolition Project. These items will be removed from the ground and released via the Property Release Evaluation (PRE) process. They will not be characterized as part of this PDS.
- This characterization package was prepared in accordance with MAN-077-DDCP, D&D Characterization Protocols, and MAN-127-PDSP, Pre-Demolition Survey Plan for D&D Facilities.
- PDSP Data Quality Objectives were used to develop this characterization package.

Instructions:

1. Verify characterization activities are on the Plan-of-the-Day (POD).
2. Perform a Pre-Evolution Brief and/or Job Task Brief in accordance with the Site Conduct of Operations Manual.
3. Verify personnel have appropriate training for the applicable tasks they will be performing.
4. Comply with RWP requirements, if applicable.
5. Comply with JHA and facility PPE requirements, as applicable.
6. Inform the Facility Manager, or designee prior to starting characterization activities.
7. Follow applicable characterization and sampling procedures.
8. Notify Wackenhut Security (x2444) and the Shift Supervisor (x2914), and verify appropriate safety precautions/requirements are followed prior to accessing facility roofs.
9. Coordination with the Environmental Restoration Program organization will be required to further characterize underneath facility foundations and slabs prior to removal.
10. Collect and maintain all characterization paperwork in the Project File(s), and all electronic data in the appropriate D&D RISS subdirectory.

ASBESTOS		
Sample Location	**Estimated Number of Samples**	**Sample location and justification/rational**
All tanks and containment/berms/ pads	0	Based on an inspection of the tanks and berms/pads, and related sampling and analysis, there is friable asbestos on the top of the two KOH tanks (TK 168 and 169). No other asbestos was identified/detected. Refer to project files. Therefore, no additional asbestos characterization is required.

BERYLLIUM		
Sample Location	**Number of Samples (smears)**	**Sample location and justification/rational**
All tanks and containment/berms/ pads	0	Based on the 371Cluster RLCR, there is adequate historical and process knowledge to conclude that beryllium was not used or stored in or around these tanks. Therefore, sampling is not required.

LEAD		
Sample Location	**Number of Samples**	**Sample location and justification/rational**
All tanks and containment/berms/ pads	0	Lead sampling is not required on these tanks and containment/berms/pads. Lead-based paints were not used.

RCRA/CERCLA CONSTITIUENTS		
Sample Location	**Number of Samples**	**Sample location and justification/rational**
All tanks and containment/berms /pads	0	Tanks 163, 164 and 165 never held RCRA/CERCLA constituents. Tank 167 stored nitric acid, and Tanks 168 and 169 stored KOH. These tanks will be emptied and rinsed, and all residual product and rinsate will be transferred to B374 for use in the B374 treatment process. No significant spills ever occurred, and any minor spills have been cleaned up. Based on this history and the nature of the products stored, it is not probable that the related demolition debris (i.e., tanks and berm material) would exhibit RCRC hazardous waste characteristics. Also, the Soil Disturbance Approval Form and associated documentation (May 2001) indicate no soil contamination, thereby indicating that the undersides of the containment, berms and pads are not contaminated. Therefore, sampling for RCRA/CERCLA constituents is not required.

PCBs		
Sample Location	**Number of Samples**	**Sample location and justification/rational**
All tanks and containment/berms/ pads	0	Based on the 371Cluster RLCR, there is adequate historical and process knowledge to conclude that PCBs were not used or stored in or around these tanks, and that PCB contamination on structural surfaces and in underlying soils is not probable. Also, paints used did not contain PCBs. Therefore, sampling is not required.

ATTACHMENT C

Radiological Survey Unit Packages

SURVEY UNIT
371002

SURVEY PACKAGE COVER SHEET

Survey Area: CC	Survey Unit: 371002	Building/Structure: T163 & 164

Survey Unit/Area Description:
West Product Water Tanks, north of Building 374. These tanks were never put into service and are currently out of service.

Building Information:

Survey Type: Reconnaissance Level Characterization Survey ☐ Pre-Demolition Survey ☑

Building Type: Type 1 ☑ Type 2 ☐ Type 3 ☐

Classification: Class 1 ☐ Class 2 ☐ Class 3 ☑ Unknown ☐

Contaminants of Concern: Plutonium ☑ Uranium ☑ Other ☐

Justification for Classification: No history of radiological operations or material storage. Areas not expected to contain any residual radioactivity greater than $DCGL_w$. No individual measurements are expected to exceed the indicated value.

Special Support Requirements: None.

Special Safety Requirements: Survey personnel shall be trained for elevated work.

Isolation Controls:
LEVEL 1 ☐ LEVEL 2 ☑ N/A ☐

No use, storage, or movement of radioactive material, with the exception of instrument check sources, is permitted in this survey unit.

Labeling Requirements: Survey locations are identified as indicated on the attached survey unit map(s). Survey location numbers will be annotated at each survey location.

Survey Package Implementation:

D. A. Barnes		[signature]	8/23/01
Radiological Engineer Printed Name	Employee #	Radiological Engineer Signature	Date
Larry Rands		[signature]	8/23/01
Radiological Engineer Printed Name	Employee #	Radiological Engineer Signature	Date

Comments:

Survey Package Closure:

Radiological Engineer Printed Name	Employee #	Radiological Engineer Signature	Date
Radiological Engineer (Peer Review) Printed Name	Employee #	Radiological Engineer (Peer Review) Signature	Date
RE Manager or RSM Printed Name	Employee #	RE Manager or RSM Signature	Date

SURVEY PACKAGE TRACKING FORM

Survey Area:	Survey Unit:	Initiator/ Date	Release Date	Validation Date	Closure Date
CC	371002				

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SURVEY PACKAGE CORRECTION/CHANGE HISTORY FORM

Survey Area:	CC	Survey Unit:	371002	Building/Structure:	T163 & 164

Change #	Description	Initiator/ Date	RE
1	Changed "Pre" & "Post" to "Alpha" & "Beta" on	Barnes/8-24-01	
	page 10.		
2	Changed Calculation Worksheet Package ID to	Barnes/9-4-01	
	"371 N Side Porject - T163 & 164".		

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SURVEY PACKAGE SURVEY/SAMPLING INSTRUCTION FORM

Survey Area:	CC	Survey Unit:	371002	Building/Structure:	T163 & 164

Survey Unit/Area Description:

West Product Water Tanks, north of Building 374. These tanks were never put into service and are currently out of service.

Minimum Survey/Sampling Measurement Requirements

Measurement	Number and Type	Comments
Surface Activity Measurements	**TOTAL SURFACE CONTAMINATION** 15 – Alpha & Beta-Gamma **REMOVABLE SURFACE CONTAMINATION** 15 – Alpha & Beta-Gamma	90-second count time required 2-minute count time required Note: All locations are denoted on survey package survey map.

RE Verification	Print Name	Employee #	Signature	Date
	D. A. Barnes		DAB	8/23/01

Surface Scanning	Number and Type	Comments
	Alpha & Beta-Gamma scans at 3% of accessible surfaces at biased locations (i.e., doorways, lower walls, floors, etc.)	Refer to attached flowchart for scanning instructions with DP6 probe.

RE Verification	Print Name	Employee #	Signature	Date
	D. A. Barnes		DAB	8/23/01

Media Samples	Number and Type	Comments
	N/A	N/A

RE Verification	Print Name	Employee #	Signature	Date

Survey Area:	CC	Survey Unit:	371002	Building/Structure:	T163 & 164

Survey Unit/Area Description:

West Product Water Tanks, north of Building 374. These tanks were never put into service and are currently out of service.

Survey/Sampling Instructions

- **NOTE:** Any changes to the Survey Package must be logged in the "Survey Package Corrections/Change History Form."
- **RCT** – If not already completed, label the survey unit surfaces per the Survey Package Cover Sheet Grid Requirements Section and the attached survey map(s).
- **RCT** – If not already completed, transpose sample numbers from attached survey maps onto each corresponding survey location on the survey unit surfaces.
- **RCT** – Perform pre-use performance checks of all instrumentation to be utilized in conjunction with this survey package. *A priori* Minimum Detectable Concentrations (MDCs) listed in the RFETS Pre-Demolition Survey Plan (PDSP) may be used. If MDCs are calculated, use the formula indicated below in the sampling instructions. Verify that computed MDCs are less than 50% of the applicable $DCGL_W$. Record all information on the Instrument Data Sheet.
- **RCT** – When calculating MDC values for smears and static field measurements, use the following equation:

$$MDC = \frac{3 + 3.29\sqrt{R_b t_s (1 + \frac{t_s}{t_b})}}{E_t (A/100) t_s}$$

Where,

R_b = Background counting rate
t_s = sample counting time interval
t_b = background counting time
E_t = total efficiency
A = physical surface area of the detector (or area sampled for smears)

Note: Ensure that a 90 second count time is utilized when determining the MDC of the NE Electra. A ten minute background and a two minute sample count time shall be used for the SAC-4. This will allow a correspondence between the MDC calculations and field measurements.

Note: Perform TSA (first) background (second), and removable measurements (third), at a location to the right of the sample location labels. If this area is not accessible, then move in a clockwise direction of the sample location label until a suitable location is revealed. DO NOT perform TSA and removable surveys on the sample location sticker itself.

- **RCT** – Obtain a local area background measurement using a shielded probe (¾ inch slab of wood that will be provided) or by turning the probe to face away from the surface being measured. Local Area Background values should be obtained at each TSA measurement location just AFTER obtaining the actual total surface activity. Place the probe shield at the same location the field measurement is to be taken and record the actual background reading (cpm) on the appropriate form.

Survey Area:	CC	Survey Unit:	371002	Building/Structure:	T163 & 164

Survey Unit/Area Description:

West Product Water Tanks, north of Building 374. These tanks were never put into service and are currently out of service.

Survey/Sampling Instructions

- **RCT** - Obtain 100cm^2 total surface activity measurements (and local area background measurements) at each labeled measurement location per 3-PRO-476-RSP 16.02, Radiological Surveys of Surfaces and Structures. Record the results on the "Total Surface Activity Data Sheet".

- **RCT** - Obtain 100cm^2 removable smears at each labeled measurement per 3-PRO-476-RSP 16.02, Radiological Surveys of Surfaces and Structures. Record the results on the "Removable Contamination Data Sheet". Ensure that a background count time of 10 minutes and a sample count time of 2 minutes is used.

- **RCT** – perform Scans and investigation scans (if applicable) as described on attached flowchart. Complete the "Scan and Investigation Data Sheet" as appropriate.

  Note (NE Electra): Given the total alpha contamination action level of 225 dpm/100 cm^2 (75% of $DCGL_{EMC}$), and a probability of detection of 67%, the appropriate scan rate for alpha measurements is 1.5 in/s (~3.81 cm/s). Upon initial detection of a single count, the surveyor should pause over the area for 4 seconds. If one or more counts is observed in that time interval (equivalent to 15 cpm on NE Electra display), the surveyor should perform a 30-second TSA on the area (Refer to Investigation Flowchart for additional guidance).

  Note (Radhound Final Survey Monitor): If the $DCGL_{EMC}$ investigation limit (225 dpm/100 cm^2) is exceeded / detected, then RCT shall perform investigation with the NE Electra in accordance with attached flowchart. Radhound Final Survey Monitor scan rates are determined utilizing incorporated software in the field (see Radhound Manual for technical basis). Areas to be scanned shall be marked to include grid location corners, at a minimum, to confirm measurement locations are traceable.

- **RCT** – When values are less than the Minimum Detectable Concentration (MDC), the actual value shall be annotated on the survey form.

- **RCT** – In the event any removable measurement exceeds 20 dpm/100cm^2 alpha, any total activity measurement exceeds 100 dpm/100cm^2 alpha, or any scan measurement exceeds 225 dpm/100cm^2 alpha, notify the cognizant Radiological Engineer. Radiological Engineering will evaluate to determine if the elevated reading represents actual DOE-added material, NORM, or statistical anomalies prior to any decision-making process or additional investigation methods.

- **RCT** - Collect QC measurements (90 sec., TSA only) at a frequency of 5% of the total number of initial measurement locations (minimum of 2 per survey unit). Do not collect measurements at locations of zero or negative initial results. QC measurements are to be collected with a different instrument and by a different technician than the original survey.

- **RCT** – Complete the attached "Instrument Data Sheet" for all instrumentation used for this final survey.

- **RCT** – Complete the attached "Survey Signature Sheet" and forward the survey package to the RCT Foreman for review.

- **RCT** - Perform post-use performance checks immediately following use, typically following the conclusion of measurements on the same day. The post-use performance checks *SHALL fall within ± 20% of the established range* to be considered acceptable.

- **RCT Supervisor** – Review the applicable forms in the survey package for completeness, complete the attached "Survey Package Validation Checklist Form" and the "Survey Signature Sheet," and forward the survey package to Characterization Radiological Engineering for final disposition.

SURVEY PACKAGE CALCULATION WORKSHEET

371 N. Side Project - T163 & 164

Package ID: ~~Bldg 865 cluster exteriors~~		Building:	T163 & 164
Survey Area:	CC	Survey Unit:	371002

Survey Unit/Area Description:

West Product Water Tanks, north of Building 374. These tanks were never put into service and are currently out of service.

☑	Total Surface Activity	☐	Media Surface Activity
☑	Removable Surface Activity	☐	Volumetric Activity

Step 1: Calculate the relative shift Δ/σ_s.

$\Delta/\sigma_s = (DCGL-LBGR)/\sigma_s$

$\Delta/\sigma_s =$

where:

- Δ/σ_s is the relative shift or the resolution of measurements in units of measurement uncertainty (MARSSIM recommends a value between 1 and 3).
- DCGL is the total surface activity derived concentration guideline value (DOE Order 5400.5 total surface activity limit equals 100 dpm/100cm^2 for transuranics)
- LBGR is the lower bound of the gray region - the lower bound of the range of values of the parameter of interest in a survey unit where the consequences of making a decision error is relatively minor. The LBGR TSA was adjusted to obtain a relative shift between I and 3 (i.e.. 40 dpm/100cm^2 for transuranics).
- σ_s is the estimated standard deviation of the total surface activity measurements (MARSSIM recommends assuming a 30% coefficient of variation if scoping or characterization data is not available)

Step 2: Determine Sign p using the calculated relative shift and Table 4. Sign p is the estimated probability that a random measurement from the survey unit will be less than the $DCGL_w$ when the survey unit median is actually at the LBGR.

Step 3: Determine Decision Error Percentiles for Z1-α and Z1-β and the selected decision error levels α and . Typical (α) and (β) values used at RFETS are 0.05 and 0.05 respectively. This yields a Z1-α and Z1-β value of 1.645 and 1.645 respectively.

Step 4: Calculate Number of Data Points (N) for Sign Test using the following equation:

$$N = \frac{(Z_{1-\alpha} + Z_{1-\beta})^2}{4(Sign\,p - 0.5)^2}$$

$N = (1.645 + 1.645)^2 / 4(\text{Sign p} - 0.5)^2$

$N = (1.645 + 1.645)^2 / 4(0.977250-0.5)^2 = 11.88$

where:

- 1.645 is the alpha and beta decision error value (95% confidence) per the PDSP.
- Sign p equals 0.977250

Step 4: Increase N by 20% to allow for missing or invalid data points per MARSSIM, Section 5.5.2.3.

$N = 11.88 * 1.2 = 14.25$

Step 5: Increase the number of data points by 20% to ensure sufficient power of the tests and to allow for possible data losses.

Conclusion: A minimum of 15 Total Surface and Removable Activity measurements will required for each survey unit.

D. A. Barnes			8/23/01
RE Printed Name	Employee #	Radiological Engineer Signature	Date
Larry Rands			8/23/01
RE (Peer Review) Print Name	Employee #	Radiological Engineer Signature	Date

Survey Area:	CC	Survey Unit:	371002	Building:	1163 & 164

Survey Unit/Area Description:

West Product Water Tanks, north of Building 374. These tanks were never put into service and are currently out of service.

SURVEY SIGNATURE SHEET

REMOVABLE/TOTAL SURFACE ACTIVITY/SCAN SURVEYS PERFORMED BY

	RCT Printed Name	Employee #	RCT Signature	Date
RCT ID # 1	Marcus Chase		Marcus Chase	8-28-01
RCT ID # 2	Kievent Parks		Kievent Parks	8-28-01
RCT ID # 3	Wm Krueger		Wm Krueger	8-28-01
RCT ID # 4	Daniel Conley		Daniel Conley	8-28-01
RCT ID # 5				
RCT ID # 6				

Quality Control Measurements Performed By

	RCT Printed Name	Employee #	RCT Signature	Date
RCT ID # 7	Marcus Chase		Marcus Chase	8-28-01
RCT ID # 8				
RCT ID # 9				
RCT ID # 10				

Survey Reviewed By

RCT Supervision Printed Name	Employee #	RCT Supervision Signature	Date
R. T. Ruffin		RTR	8-28-01

Survey Area:	CC	Survey Unit:	371002	Building:	T163 & 164

Survey Unit/Area Description:

West Product Water Tanks, north of Building 374. These tanks were never put into service and are currently out of service.

INSTRUMENT DATA SHEET

Removable Activity Survey Instrument Data

Manufacturer	Eberlinee	Eberline				
Model	SAC-4	BC-4				
Serial #	1428	960				
Cal. Due Date	2/11/02	8/31/01				
ANALYSIS DATE	8/25/01	8/25/01				
Alpha Bkgd. (cpm)	0.6					
Alpha Eff. (c/d)	33.0%					
Intrument α MDC ($dpm/100cm^2$)	10.0					
Beta Bkgd. (cpm)		26.3				
Beta Eff. (c/d)		25.0%				
Intrument β MDC ($dpm/100cm^2$)		200				

Total Surface Activity Instrument Data

Manufacturer	NE	NE	NE	NE	NE	NE
Model	Electra	Electra	Electra	Electra	Electra	Electra
Serial #	1380	1354	1438	1526	2146	1526
Cal. Due Date	10/3/01	1/10/02	2/7/02	1/11/02	11/14/01	1/11/02
ANALYSIS DATE	8/24/01	8/24/01	8/24/01	8/24/01	8/24/01	8/29/01
Alpha Bkgd. (cpm)	2.0	3.8	3.0	2.0	2.0	4.0
Alpha Eff. (c/d)	21.8%	21.8%	21.6%	21.1%	22.1%	21.1%
Intrument α MDC ($dpm/100cm^2$)	48	48	48	48	48	48
Beta Bkgd. (cpm)	467	467	483	345	422	
Beta Eff. (c/d)	33.5%	31.7%	31.5%	29.8%	33.9%	
Intrument β MDC ($dpm/100cm^2$)	318	318	318	318	318	

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Survey Area: CC	Survey Unit: 371002	Building: T163 & 164

Survey Unit/Area Description:

West Product Water Tanks, north of Building 374. These tanks were never put into service and are currently out of service.

Total Surface Activity Data Sheet

Sample Location	Material Type (If Required)	Alpha Total Surface Activity Measurements				Beta-Gamma Total Surface Activity Measurements			
		RCT ID #	Inst. ID #	Gross (cpm)	LAB (cpm)	RCT ID #	Inst. ID #	Gross (cpm)	LAB (cpm)
1	Metal	4	5	12.0	4.0	4	5	371	389
2		4	5	6.0	3.3	4	5	818	556
3		4	5	26.0	9.5	4	5	835	668
4		4	5	6.0	0.7	4	5	395	480
5		4	5	7.3	6.7	4	5	367	387
6		4	5	8.7	6.7	4	5	773	644
7		1	5	12.0	1.3	1	5	349	377
8		1	5	14.7	6.7	1	5	365	373
9		2	5	9.3	5.3	2	5	849	847
10		3	5	8.7	7.3	3	5	367	417
11		3	5	3.3	4.0	3	5	421	531
12		1	5	2.0	4.7	1	5	476	545
13		2	5	5.3	3.3	2	5	990	853
14		3	5	3.3	4.0	3	5	435	518
15	Metal	2	5	7.3	6.7	2	5	406	389
16									
17									
18									
19									
20									
3 QC	Metal	7	4	20.0	9.3	7	4	701	668
8 QC	Metal	7	4	12.7	6.7	7	4	310	373

Comments:

COUNT TIME = 90 (SEC)

Note: QC measurements are to be collected with a different instrument than the original survey. Mark the QC location number in the "Sample Location" column.

Survey Area:	CC	Survey Unit:	371002	Building:	T163 & 164

Survey Unit/Area Description:

West Product Water Tanks, north of Building 374. These tanks were never put into service and are currently out of service.

Removable Activity Data Sheet

Location #	RCT ID #	Inst. ID #		Gross counts	
		α	β	α	β
1	1	1	2	3.0	61
2	1	1	2	0.0	60
3	1	1	2	1.0	57
4	1	1	2	2.0	72
5	1	1	2	2.0	56
6	1	1	2	1.0	63
7	1	1	2	0.0	62
8	1	1	2	3.0	57
9	2	1	2	1.0	66
10	2	1	2	0.0	63
11	2	1	2	2.0	65
12	2	1	2	1.0	71
13	2	1	2	0.0	69
14	2	1	2	0.0	58
15	2	1	2	2.0	55
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					

Comments:

All readings from SAC-4 & BC-4 are 2 minute counts.

COUNT TIME = 120 (SEC)

Survey Area: CC	Survey Unit: 371002	Building: T163 & 164

Survey Unit/Area Description:

West Product Water Tanks, north of Building 374. These tanks were never put into service and are currently out of service.

Scan Survey/Investigation Documentation Formt

Location #	NE Electra Alpha					NE Electra Beta			
	RCT ID #	Inst. ID #	4-sec Audible observed? "Y" or "N"	30-sec Static (gcpm)	90-sec Direct (dpm/100cm^2)	RCT ID #	Inst. ID #	Elevated Audible observed? "Y" or "N"	60-sec Direct (dpm/100cm^2)
M1	1	1	Yes	4					
M2	1	1	Yes	2					
M3	1	1	Yes	6					
K4	2	1	Yes	6					
M5	1	1	Yes	12					
M6	1	1	Yes	4					
M7	1	1	Yes	8					
03a	2	6	na	na	121				
03b	2	6	na	na	132				
03c	2	6	na	na	149				

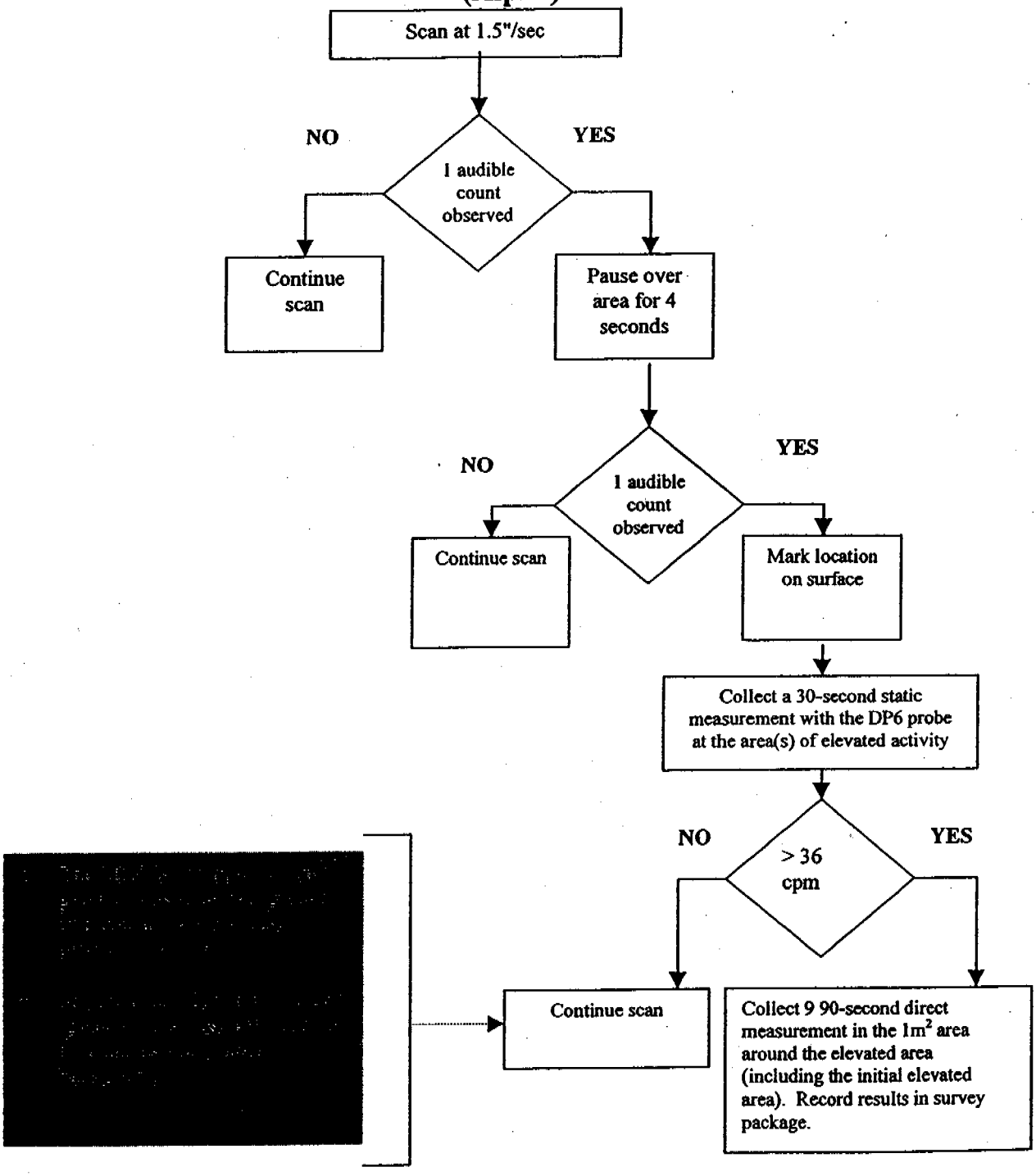
NOTE: Refer to the Instrument Data Sheet and Survey Signature Sheet for instrumentation, surveyor & approval information.

Results/Comments:

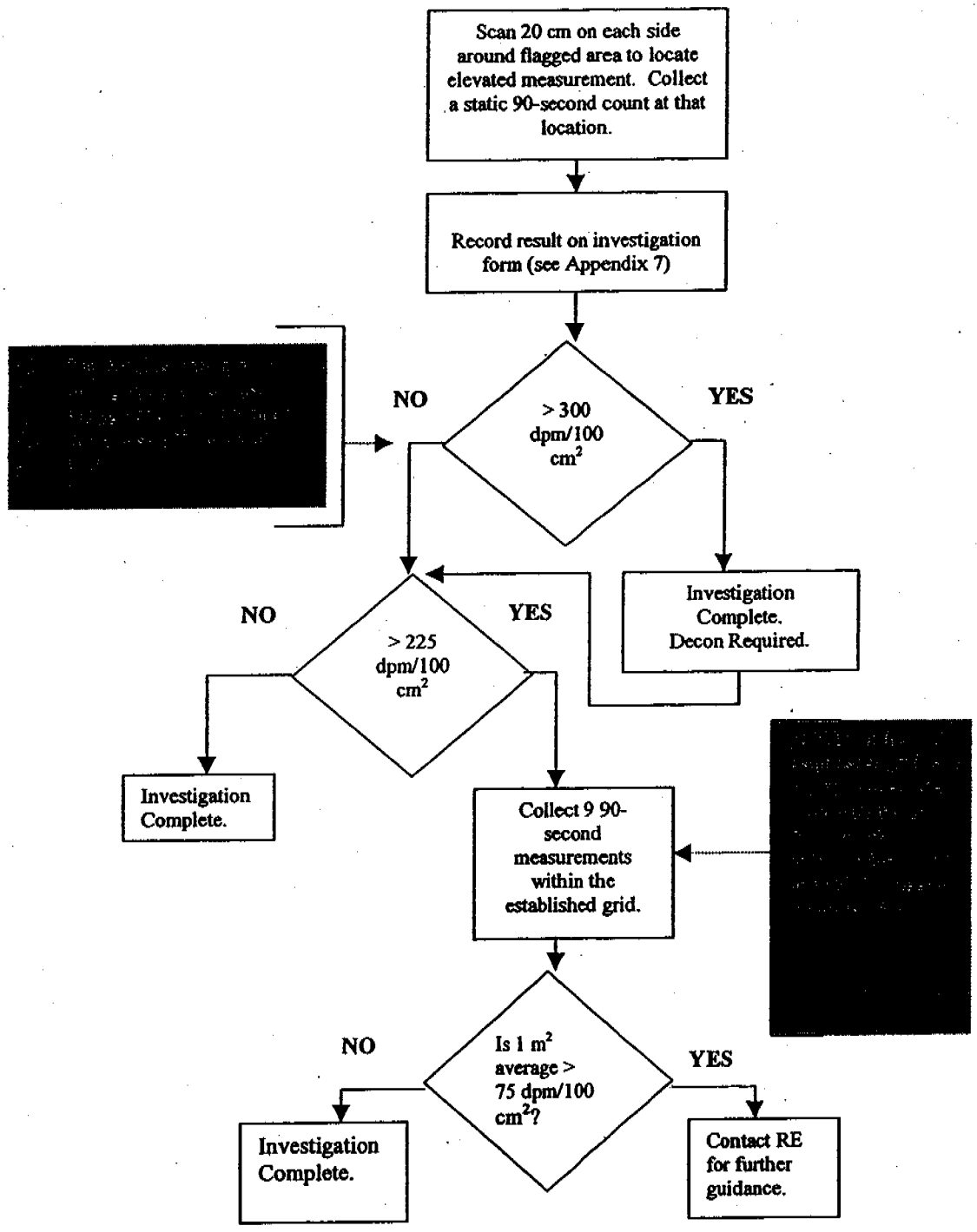
18 m^2 scanned.

No measurements >36 cpm/100cm^2 α.

Scan Method with DP6 (example)
(Alpha)



Investigation Method with DP6 (example) (Alpha)



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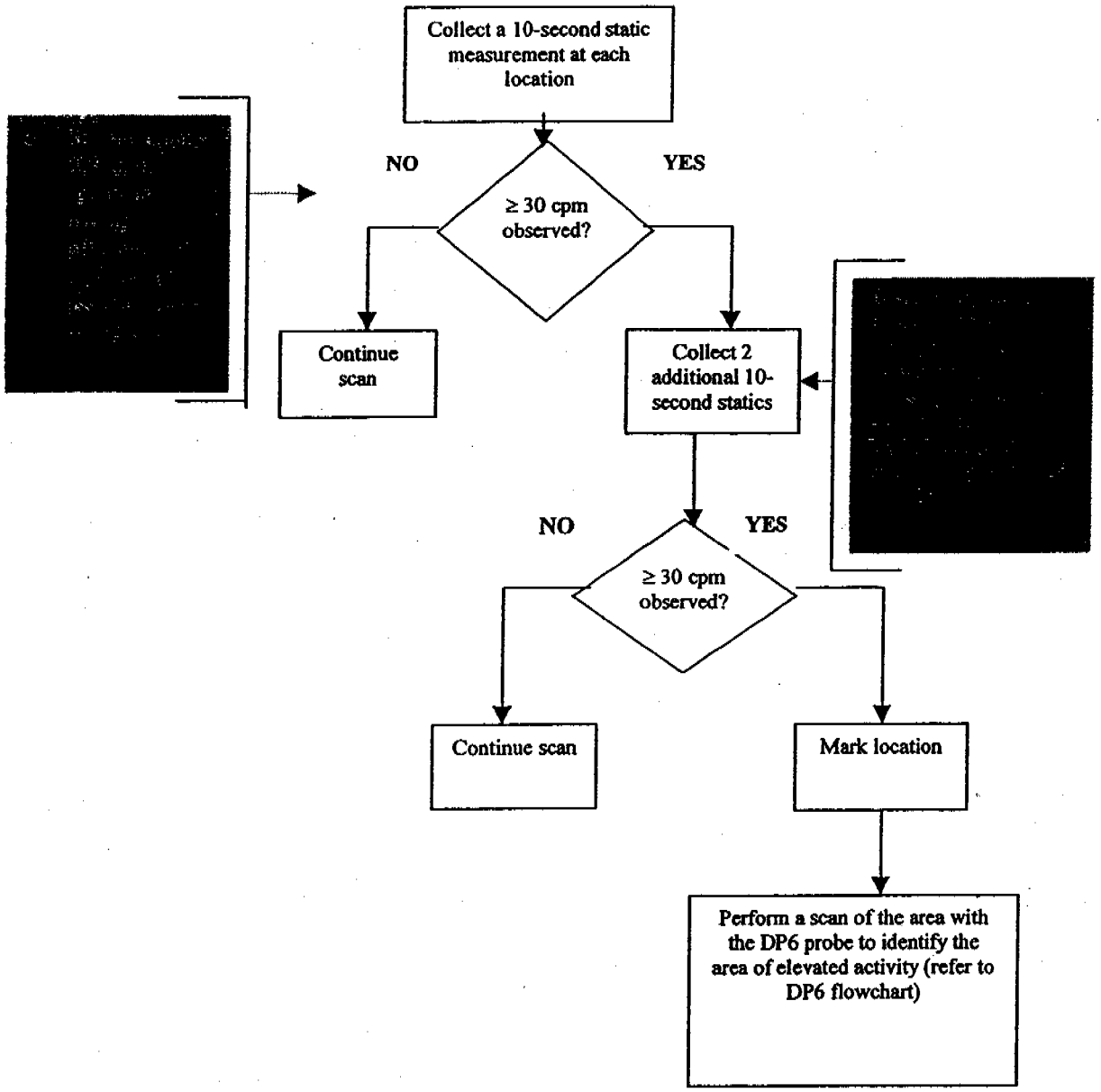
Alpha Scan Method with DP8A or equivalent (example)
Revision 1



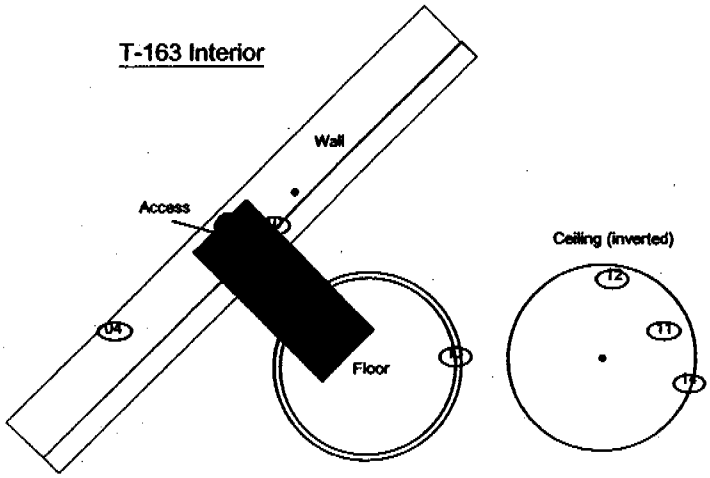
RADIOLOGICAL CLOSEOUT SURVEY FOR

Survey Area: NA **Survey Unit: 371002** **Classification: 3**
Building: 374
Survey Unit Description: T-163

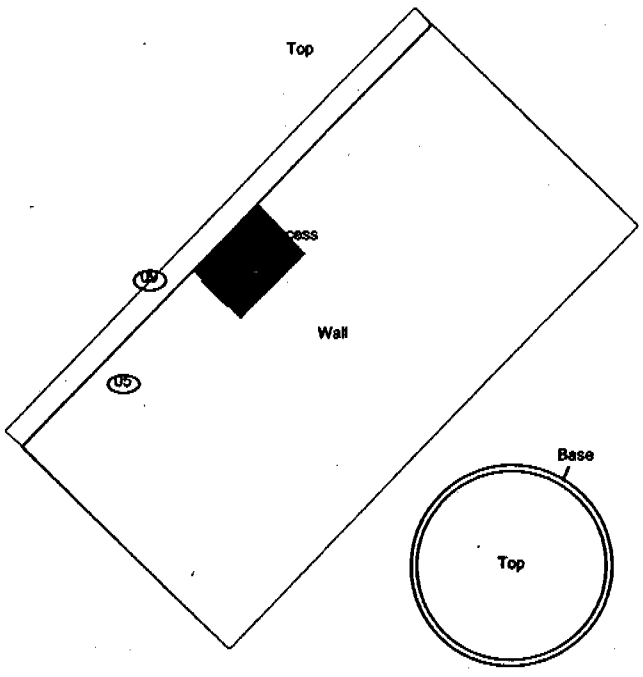
Total Floor Area: NA **Total Area: 463 sq. m** **Grid Size: N/A**

SURVEY UNIT - MAP 1 OF 1

T-163 Interior



T-163 Exterior



Scanned Areas

N

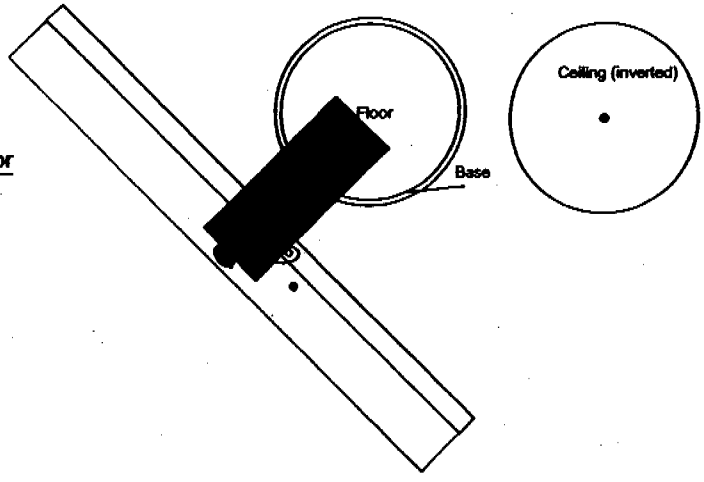
RADIOLOGICAL CLOSEOUT SURVEY FOR

Survey Area: NA **Survey Unit: 371002** **Classification: 3**
Building:374
Survey Unit Description: T-164

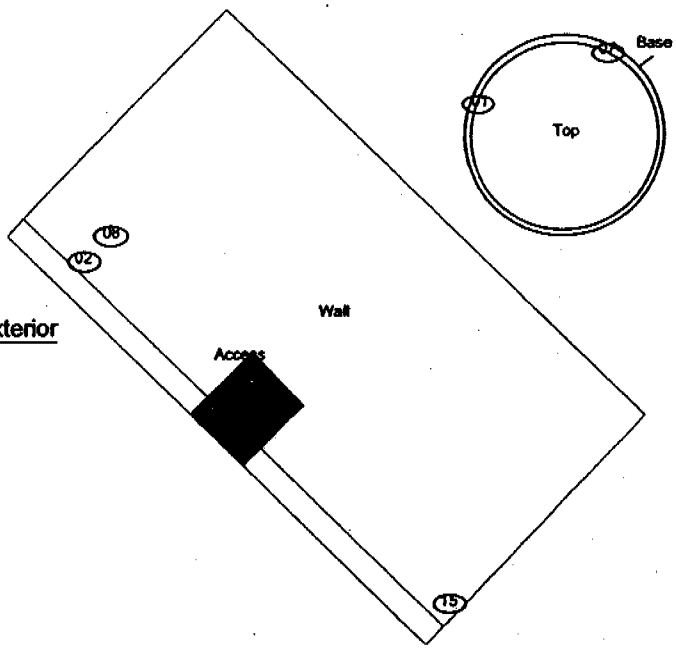
Total Floor Area: NA **Total Area: 463 sq. m** **Grid Size: N/A**

SURVEY UNIT - MAP 1 OF 1

T-164 Interior



T-164 Exterior



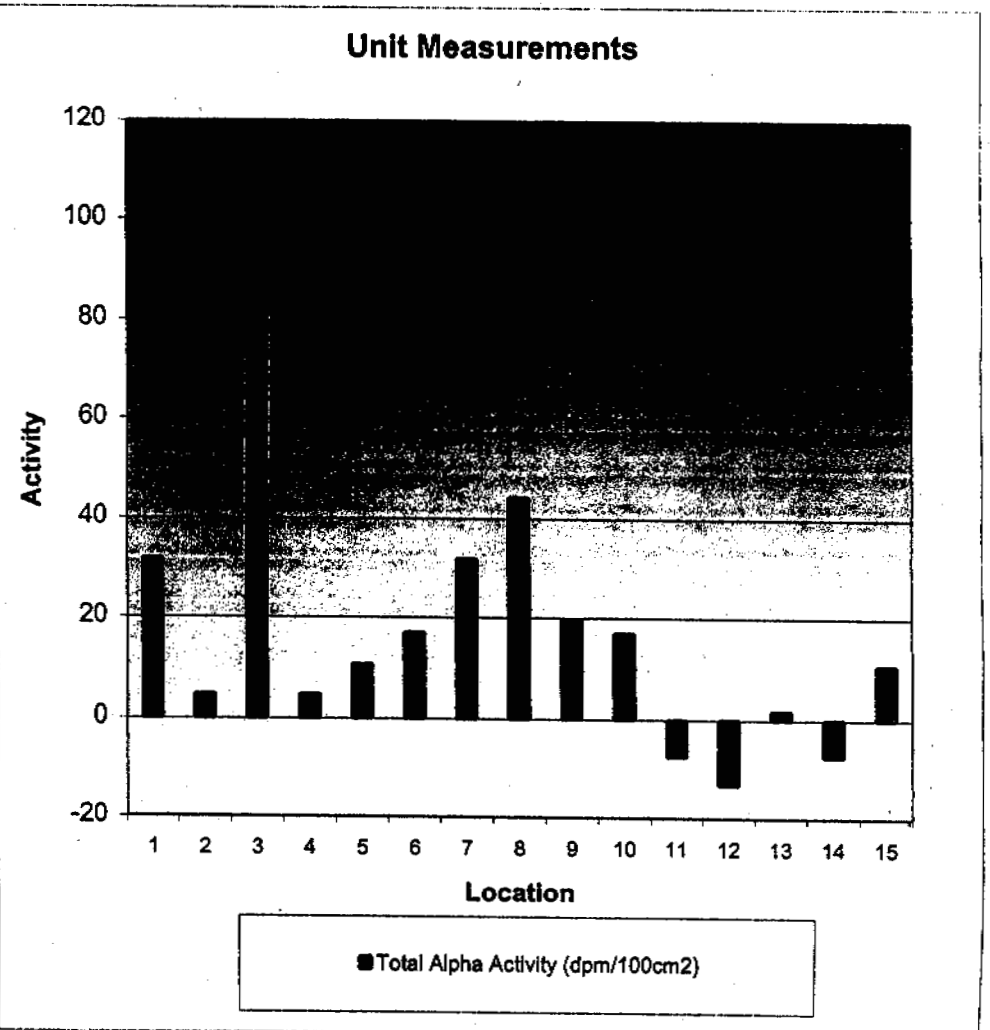
Scanned Areas

N

TSA Alpha **371002** 8/24/01

				Instument	1526	2146
standard deviation:	26.8	max:	95.3	Ave. Instrument background:	8.0 cpm	4.9 cpm
mean:	17.4	min:	-13.3	Instrument efficiency:	21.1%	22.1%
median:	10.6			Instrument MDA:	48 dpm	48 dpm

	Surface Location	Total Alpha Counts (cpm/100cm²)	Local Area Bkgd (cpm/100cm²)	Total Alpha Activity (dpm/100cm²)	TotalAlpha DCGL (dpm/100cm²)
1	Tanks 163 &164	12.0	4.0	31.9	100
2	Tanks 163 &164	6.0	3.3	4.8	100
3	Tanks 163 &164	26.0	9.5	95.3	100
4	Tanks 163 &164	6.0	0.7	4.8	100
5	Tanks 163 &164	7.3	6.7	10.6	100
6	Tanks 163 &164	8.7	6.7	17.0	100
7	Tanks 163 &164	12.0	1.3	31.9	100
8	Tanks 163 &164	14.7	6.7	44.1	100
9	Tanks 163 &164	9.3	5.3	19.7	100
10	Tanks 163 &164	8.7	7.3	17.0	100
11	Tanks 163 &164	3.3	4.0	-7.5	100
12	Tanks 163 &164	2.0	4.7	-13.3	100
13	Tanks 163 &164	5.3	3.3	1.6	100
14	Tanks 163 &164	3.3	4.0	-7.5	100
15	Tanks 163 &164	7.3	6.7	10.6	100
3 QC	Tanks 163 &164	20.0	9.3	56.9	100
8 QC	Tanks 163 &164	12.7	6.7	22.3	100



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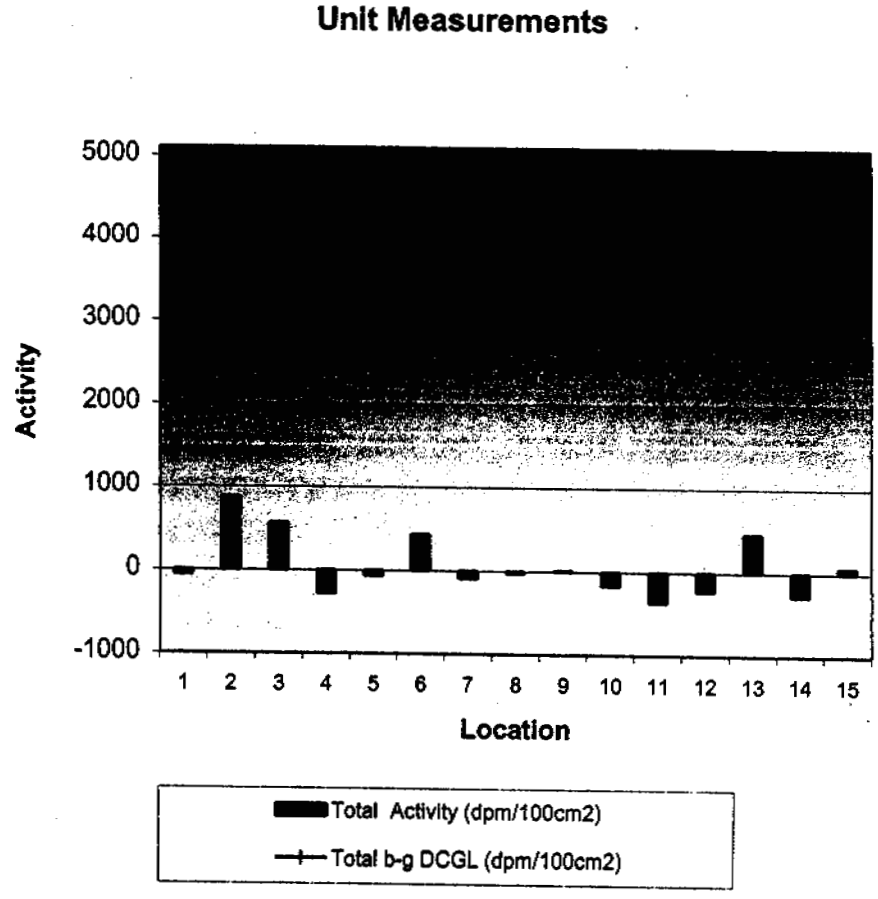
Total TSA Beta-Gamma

371002

8/24/01

				Instument	1526	2146
standard deviation:	362.5	max:	879.2	Ave. Instrument background:	520.5 cpm	531.6 cpm
mean:	54.4	min:	-369.1	Instrument efficiency:	29.8%	33.90%
median:	-60.4			Instrument MDA:	318 dpm	318 dpm

	Surface Location	Total Counts (cpm/100cm²)	Local AreaBkgd (cpm/100cm²)	Total Activity (dpm/100cm²)	Total β–γ DCGL (dpm/100cm²)
1	Tanks 163 &164	371.0	389.0	-60.4	5000
2	Tanks 163 &164	818.0	556.0	879.2	5000
3	Tanks 163 &164	835.0	668.0	560.4	5000
4	Tanks 163 &164	395.0	480.0	-285.2	5000
5	Tanks 163 &164	367.0	387.0	-67.1	5000
6	Tanks 163 &164	773.0	644.0	432.9	5000
7	Tanks 163 &164	349.0	377.0	-94.0	5000
8	Tanks 163 &164	365.0	373.0	-26.8	5000
9	Tanks 163 &164	849.0	847.0	6.7	5000
10	Tanks 163 &164	367.0	417.0	-167.8	5000
11	Tanks 163 &164	421.0	531.0	-369.1	5000
12	Tanks 163 &164	476.0	545.0	-231.5	5000
13	Tanks 163 &164	990.0	853.0	459.7	5000
14	Tanks 163 &164	435.0	518.0	-278.5	5000
15	Tanks 163 &164	406.0	389.0	57.0	5000
3 QC	Tanks 163 &164	701.0	668.0	97.3	5000
8 QC	Tanks 163 &164	310.0	373.0	-185.8	5000



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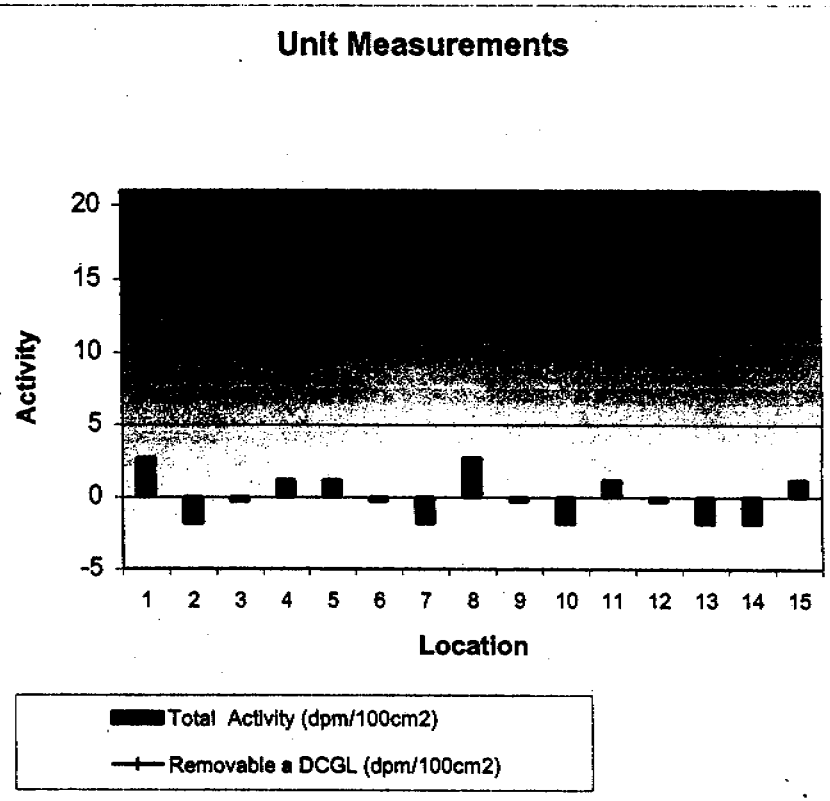
Removable Activity - Alpha

371002

8/24/01

				Instument:	1428
standard deviation:	1.6	max:	2.7	Instrument background:	0.6 cpm
mean:	0.0	min:	-1.8	Instrument efficiency:	33.0%
median:	-0.3			Instrument MDA:	10 dpm

	Surface Location	Total Counts (cpm/100cm²)	Bkgd (cpm/100cm²)	Total Activity (dpm/100cm²)	Removable α DCGL (dpm/100cm²)
1	Tanks 163 &164	1.5	0.6	2.7	20
2	Tanks 163 &164	0.0	0.6	-1.8	20
3	Tanks 163 &164	0.5	0.6	-0.3	20
4	Tanks 163 &164	1.0	0.6	1.2	20
5	Tanks 163 &164	1.0	0.6	1.2	20
6	Tanks 163 &164	0.5	0.6	-0.3	20
7	Tanks 163 &164	0.0	0.6	-1.8	20
8	Tanks 163 &164	1.5	0.6	2.7	20
9	Tanks 163 &164	0.5	0.6	-0.3	20
10	Tanks 163 &164	0.0	0.6	-1.8	20
11	Tanks 163 &164	1.0	0.6	1.2	20
12	Tanks 163 &164	0.5	0.6	-0.3	20
13	Tanks 163 &164	0.0	0.6	-1.8	20
14	Tanks 163 &164	0.0	0.6	-1.8	20
15	Tanks 163 &164	1.0	0.6	1.2	20



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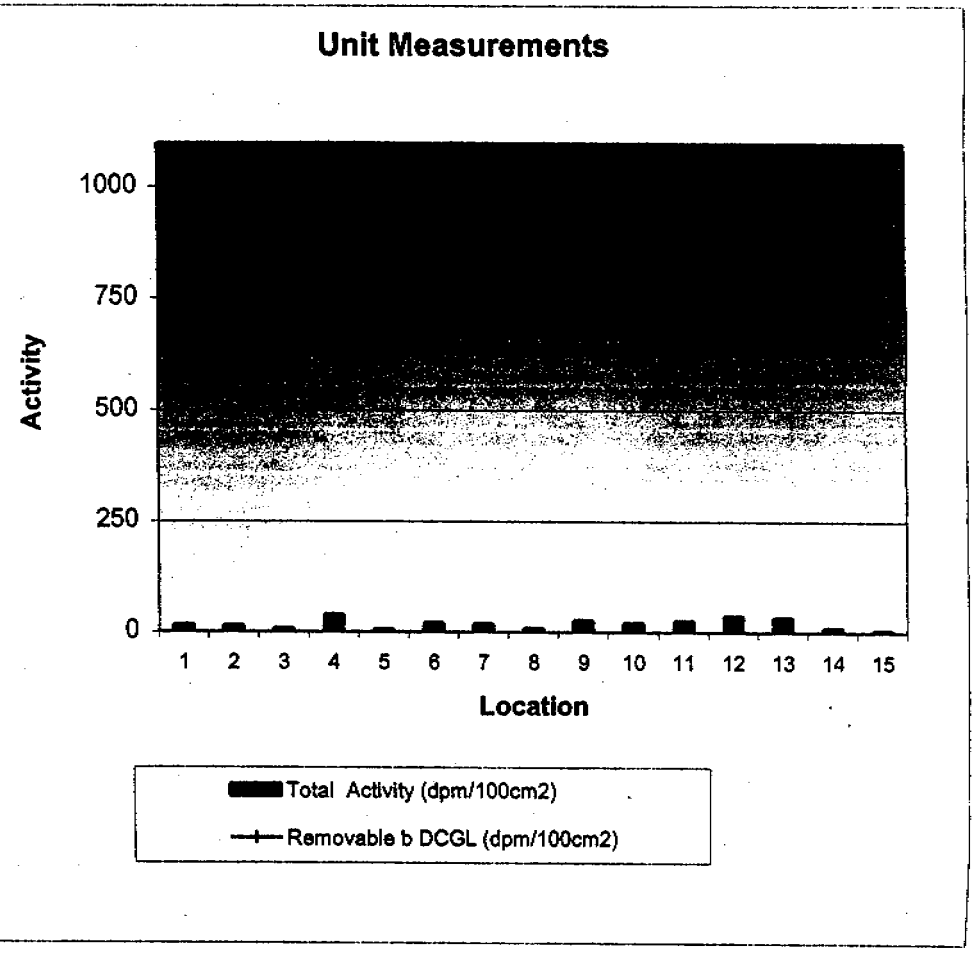
Removable Activity - Beta-Gamma

371002

8/24/01

				Instument:	960
standard deviation:	10.8	max:	38.8	Instrument background:	26.3 cpm
mean:	19.5	min:	4.8	Instrument efficiency:	25.0%
median:	18.8			Instrument MDA:	200 dpm

	Surface Location	Total Counts (cpm/100cm²)	Local Area Bkgd (cpm/100cm²)	Total Activity (dpm/100cm²)	Removable β DCGL (dpm/100cm²)
1	Tanks 163 &164	30.5	26.3	16.8	1000
2	Tanks 163 &164	30.0	26.3	14.8	1000
3	Tanks 163 &164	28.5	26.3	8.8	1000
4	Tanks 163 &164	36.0	26.3	38.8	1000
5	Tanks 163 &164	28.0	26.3	6.8	1000
6	Tanks 163 &164	31.5	26.3	20.8	1000
7	Tanks 163 &164	31.0	26.3	18.8	1000
8	Tanks 163 &164	28.5	26.3	8.8	1000
9	Tanks 163 &164	33.0	26.3	26.8	1000
10	Tanks 163 &164	31.5	26.3	20.8	1000
11	Tanks 163 &164	32.5	26.3	24.8	1000
12	Tanks 163 &164	35.5	26.3	36.8	1000
13	Tanks 163 &164	34.5	26.3	32.8	1000
14	Tanks 163 &164	29.0	26.3	10.8	1000
15	Tanks 163 &164	27.5	26.3	4.8	1000
16					
17					



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SURVEY UNIT
371003

SURVEY PACKAGE COVER SHEET

Survey Area: CC	Survey Unit: 371003	Building/Structure: T163/164 Berm

Survey Unit/Area Description:
West Product Water Tanks secondary containment. It is approximately 4 feet deep with concrete walls and floor.

Building Information:

Survey Type: Reconnaissance Level Characterization Survey ☐ Pre-Demolition Survey ☑

Building Type: Type 1 ☑ Type 2 ☐ Type 3 ☐

Classification: Class 1 ☐ Class 2 ☐ Class 3 ☑ Unknown ☐

Contaminants of Concern: Plutonium ☑ Uranium ☑ Other ☐

Justification for Classification: No history of radiological operations or material storage. Areas not expected to contain any residual radioactivity greater than $DCGL_w$. No individual measurements are expected to exceed the indicated value.

Special Support Requirements: None.

Special Safety Requirements: Survey personnel shall be trained for ladder safety.

Isolation Controls:
LEVEL 1 ☐ LEVEL 2 ☑ N/A ☐

No use, storage, or movement of radioactive material, with the exception of instrument check sources, is permitted in this survey unit.

Labeling Requirements: Survey locations are identified as indicated on the attached survey unit map(s). Survey location numbers will be annotated at each survey location.

Survey Package Implementation:

D. A. Barnes			8/23/01
Radiological Engineer Printed Name	Employee #	Radiological Engineer Signature	Date
Larry Rands			8/23/01
Radiological Engineer Printed Name	Employee #	Radiological Engineer Signature	Date

Comments:

Survey Package Closure:

D. A. BARNES			8-28-01
Radiological Engineer Printed Name	Employee #	Radiological Engineer Signature	Date
L.L. RANDS			8/28/01
Radiological Engineer (Peer Review) Printed Name	Employee #	Radiological Engineer (Peer Review) Signature	Date
DJ DAVIDSON			8/28/01
RE Manager or RSM Printed Name	Employee #	RE Manager or RSM Signature	Date

(PRO-475-RSP-16.01, effective 05/22/01)

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SURVEY PACKAGE TRACKING FORM

Survey Area:	Survey Unit:	Initiator/ Date	Release Date	Validation Date	Closure Date
CC	371003				

(PRO-475-RSP-16.01, effective 05/22/01)

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SURVEY PACKAGE CORRECTION/CHANGE HISTORY FORM

Survey Area:	CC	Survey Unit:	371003	Building/Structure:	T163/164 Berm

Change #	Description	Initiator/ Date	RE
1	Changed "Pre" & "Post" to "Alpha" & "Beta" on	Barnes/8-24-01	
	page 10.		
2	Changed Calculation Worksheet Package ID to	Barnes/9-4-01	
	"371 N Side Project - T163 & 164 berm".		

(PRO-475-RSP-16.01, effective 05/22/01)

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SURVEY PACKAGE SURVEY/SAMPLING INSTRUCTION FORM

Survey Area:	CC	Survey Unit:	371003	Building/Structure:	T163/164 Berm

Survey Unit/Area Description:

West Product Water Tanks secondary containment. It is approximately 4 feet deep with concrete walls and floor.

Minimum Survey/Sampling Measurement Requirements

Measurement	Number and Type	Comments
Surface Activity Measurements	**TOTAL SURFACE CONTAMINATION** 15 – Alpha & Beta-Gamma **REMOVABLE SURFACE CONTAMINATION** 15 – Alpha & Beta-Gamma	90-second count time required 2-minute count time required Note: All locations are denoted on survey package survey map.
RE Verification	D. A. Barnes (Print Name) / Employee # / D. A. Barnes (Signature) / 8/23/01 (Date)	
Surface Scanning	Alpha & Beta-Gamma scans at 3% of accessible surfaces at biased locations (i.e., doorways, lower walls, floors, etc.)	Refer to attached flowchart for scanning instructions with DP6 probe.
RE Verification	D. A. Barnes (Print Name) / Employee # / D. A. Barnes (Signature) / 8/23/01 (Date)	
Media Samples	N/A	N/A
RE Verification	Print Name / Employee # / Signature / Date	

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Survey Area: CC	Survey Unit: 371003	Building/Structure: T163/164 Berm

Survey Unit/Area Description:

West Product Water Tanks secondary containment. It is approximately 4 feet deep with concrete walls and floor.

Survey/Sampling Instructions

- **NOTE:** Any changes to the Survey Package must be logged in the "Survey Package Corrections/Change History Form."
- **RCT** – If not already completed, label the survey unit surfaces per the Survey Package Cover Sheet Grid Requirements Section and the attached survey map(s).
- **RCT** – If not already completed, transpose sample numbers from attached survey maps onto each corresponding survey location on the survey unit surfaces.
- **RCT** – Perform pre-use performance checks of all instrumentation to be utilized in conjunction with this survey package. *A priori* Minimum Detectable Concentrations (MDCs) listed in the RFETS Pre-Demolition Survey Plan (PDSP) may be used. If MDCs are calculated, use the formula indicated below in the sampling instructions. Verify that computed MDCs are less than 50% of the applicable $DCGL_W$. Record all information on the Instrument Data Sheet.
- **RCT** – When calculating MDC values for smears and static field measurements, use the following equation:

$$MDC = \frac{3 + 3.29\sqrt{R_b t_s (1 + \frac{t_s}{t_b})}}{E_t (A/100) t_s}$$

Where,

R_b = Background counting rate
t_s = sample counting time interval
t_b = background counting time
E_t = total efficiency
A = physical surface area of the detector (or area sampled for smears)

Note: Ensure that a 90 second count time is utilized when determining the MDC of the NE Electra. A ten minute background and a two minute sample count time shall be used for the SAC-4. This will allow a correspondence between the MDC calculations and field measurements.

Note: Perform TSA (first) background (second), and removable measurements (third), at a location to the right of the sample location labels. If this area is not accessible, then move in a clockwise direction of the sample location label until a suitable location is revealed. DO NOT perform TSA and removable surveys on the sample location sticker itself.

- **RCT** – Obtain a local area background measurement using a shielded probe (¾ inch slab of wood that will be provided) or by turning the probe to face away from the surface being measured. Local Area Background values should be obtained at each TSA measurement location just AFTER obtaining the actual total surface activity. Place the probe shield at the same location the field measurement is to be taken and record the actual background reading (cpm) on the appropriate form.

Survey Area:	CC	Survey Unit:	371003	Building/Structure:	T163/164 Berm

Survey Unit/Area Description:

West Product Water Tanks secondary containment. It is approximately 4 feet deep with concrete walls and floor.

Survey/Sampling Instructions

- RCT - Obtain 100cm^2 total surface activity measurements (and local area background measurements) at each labeled measurement location per 3-PRO-476-RSP 16.02, Radiological Surveys of Surfaces and Structures. Record the results on the "Total Surface Activity Data Sheet".

- RCT - Obtain 100cm^2 removable smears at each labeled measurement per 3-PRO-476-RSP 16.02, Radiological Surveys of Surfaces and Structures. Record the results on the "Removable Contamination Data Sheet". Ensure that a background count time of 10 minutes and a sample count time of 2 minutes is used.

- RCT – perform Scans and investigation scans (if applicable) as described on attached flowchart. Complete the "Scan and Investigation Data Sheet" as appropriate.

  Note (NE Electra): Given the total alpha contamination action level of 225 dpm/100 cm^2 (75% of $DCGL_{EMC}$), and a probability of detection of 67%, the appropriate scan rate for alpha measurements is 1.5 in/s (~3.81 cm/s). Upon initial detection of a single count, the surveyor should pause over the area for 4 seconds. If one or more counts is observed in that time interval (equivalent to 15 cpm on NE Electra display), the surveyor should perform a 30-second TSA on the area (Refer to Investigation Flowchart for additional guidance).

  Note (Radhound Final Survey Monitor): If the $DCGL_{EMC}$ investigation limit (225 dpm/100 cm^2) is exceeded / detected, then RCT shall perform investigation with the NE Electra in accordance with attached flowchart. Radhound Final Survey Monitor scan rates are determined utilizing incorporated software in the field (see Radhound Manual for technical basis). Areas to be scanned shall be marked to include grid location corners, at a minimum, to confirm measurement locations are traceable.

- RCT – When values are less than the Minimum Detectable Concentration (MDC), the actual value shall be annotated on the survey form.

- RCT – In the event any removable measurement exceeds 20 dpm/100cm^2 alpha, any total activity measurement exceeds 100 dpm/100cm^2 alpha, or any scan measurement exceeds 225 dpm/100cm^2 alpha, notify the cognizant Radiological Engineer. Radiological Engineering will evaluate to determine if the elevated reading represents actual DOE-added material, NORM, or statistical anomalies prior to any decision-making process or additional investigation methods.

- RCT - Collect QC measurements (90 sec., TSA only) at a frequency of 5% of the total number of initial measurement locations (minimum of 2 per survey unit). Do not collect measurements at locations of zero or negative initial results. QC measurements are to be collected with a different instrument and by a different technician than the original survey.

- RCT – Complete the attached "Instrument Data Sheet" for all instrumentation used for this final survey.

- RCT – Complete the attached "Survey Signature Sheet" and forward the survey package to the RCT Foreman for review.

- RCT - Perform post-use performance checks immediately following use, typically following the conclusion of measurements on the same day. The post-use performance checks SHALL fall within ± 20% of the established range to be considered acceptable.

- RCT Supervisor – Review the applicable forms in the survey package for completeness, complete the attached "Survey Package Validation Checklist Form" and the "Survey Signature Sheet," and forward the survey package to Characterization Radiological Engineering for final disposition.

SURVEY PACKAGE CALCULATION WORKSHEET

371 N. SIDE PROJECT - T163/164 BERM

Package ID: ~~Bldg 865 cluster exteriors~~ 6-4-01		Building:	T163/164 Berm
Survey Area:	CC	Survey Unit:	371003

Survey Unit/Area Description:

West Product Water Tanks secondary containment. It is approximately 4 feet deep with concrete walls and floor.

☑	**Total Surface Activity**	☐	**Media Surface Activity**
☑	**Removable Surface Activity**	☐	**Volumetric Activity**

Step 1: Calculate the relative shift Δ/σ_s.

$\Delta/\sigma_s = (DCGL-LBGR)/\sigma_s$

$\Delta/\sigma_s =$

where:

- Δ/σ_s is the relative shift or the resolution of measurements in units of measurement uncertainty (MARSSIM recommends a value between 1 and 3).
- DCGL is the total surface activity derived concentration guideline value (DOE Order 5400.5 total surface activity limit equals 100 dpm/100cm^2 for transuranics)
- LBGR is the lower bound of the gray region - the lower bound of the range of values of the parameter of interest in a survey unit where the consequences of making a decision error is relatively minor. The LBGR TSA was adjusted to obtain a relative shift between 1 and 3 (i.e.. 40 dpm/100cm^2 for transuranics).
- σ_s is the estimated standard deviation of the total surface activity measurements (MARSSIM recommends assuming a 30% coefficient of variation if scoping or characterization data is not available)

Step 2: Determine Sign p using the calculated relative shift and Table 4. Sign p is the estimated probability that a random measurement from the survey unit will be less than the $DCGL_w$ when the survey unit median is actually at the LBGR.

Step 3: Determine Decision Error Percentiles for Z1-α and Z1-β and the selected decision error levels α and . Typical (α) and (β) values used at RFETS are 0.05 and 0.05 respectively. This yields a Z1-α and Z1-β value of 1.645 and 1.645 respectively.

Step 4: Calculate Number of Data Points (N) for Sign Test using the following equation:

$$N = \frac{(Z_{1-\alpha} + Z_{1-\beta})^2}{4(Sign\,p - 0.5)^2}$$

$N = (1.645 + 1.645)^2 / 4(\text{Sign p} - 0.5)^2$

$N = (1.645 + 1.645)^2 / 4(0.977250-0.5)^2 = 11.88$

where:

- 1.645 is the alpha and beta decision error value (95% confidence) per the PDSP.
- Sign p equals 0.977250

Step 4: Increase N by 20% to allow for missing or invalid data points per MARSSIM, Section 5.5.2.3.

$N = 11.88 * 1.2 = 14.25$

Step 5: Increase the number of data points by 20% to ensure sufficient power of the tests and to allow for possible data losses.

Conclusion: A minimum of 15 Total Surface and Removable Activity measurements will required for each survey unit.

D. A. Barnes	-		8/23/01
RE Printed Name	Employee #	Radiological Engineer Signature	Date
Larry Rands			8/23/01
RE (Peer Review) Print Name	Employee #	Radiological Engineer Signature	Date

Survey Area: CC	Survey Unit: 371003	Building: T163/164 Berm

Survey Unit/Area Description:
West Product Water Tanks secondary containment. It is approximately 4 feet deep with concrete walls and floor.

SURVEY SIGNATURE SHEET

REMOVABLE/TOTAL SURFACE ACTIVITY/SCAN SURVEYS PERFORMED BY

	RCT Printed Name	Employee #	RCT Signature	Date
RCT ID # 1	Marcus Chase		Marcus Chase	8-28-01
RCT ID # 2	Kieven Parks		Kieven Parks	8.28.01
RCT ID # 3	Anita Vaie			8-28-01
RCT ID # 4	F.F. Riddle			8-28-01
RCT ID # 5				
RCT ID # 6				

Quality Control Measurements Performed By

	RCT Printed Name	Employee #	RCT Signature	Date
RCT ID # 7	Kieven Parks		Kieven Parks	8-28-01
RCT ID # 8				
RCT ID # 9				
RCT ID # 10				

Survey Reviewed By

RCT Supervision Printed Name	Employee #	RCT Supervision Signature	Date
R.T. Ruffin		RSRuffin	8-28-01

Survey Area:	CC	Survey Unit:	371003	Building:	T163/164 Berm

Survey Unit/Area Description:

West Product Water Tanks secondary containment. It is approximately 4 feet deep with concrete walls and floor.

INSTRUMENT DATA SHEET

Removable Activity Survey Instrument Data

Manufacturer	Eberlinee	Eberline	Eberline	Eberline		
Model	SAC-4	SAC-4	BC-4	BC-4		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Serial #	1430	1428	960	872		
Cal. Due Date	11/3/01	2/11/02	8/31/01	7/26/02		
ANALYSIS DATE	8/25/01	8/25/01	8/25/01	8/25/01		
Alpha Bkgd. (cpm)	0.1	0.6	[illegible]	[illegible]		
Alpha Eff. (c/d)	33.0%	33.0%	[illegible]	[illegible]		
Intrument α MDC ($dpm/100cm^2$)	10.0	10.0	[illegible]	[illegible]		
Beta Bkgd. (cpm)	[illegible]	[illegible]	26.3	36.7		
Beta Eff. (c/d)	[illegible]	[illegible]	25.0%	25.0%		
Intrument β MDC ($dpm/100cm^2$)	[illegible]	[illegible]	200	200		

Total Surface Activity Instrument Data

Manufacturer	NE	NE	NE			
Model	Electra	Electra	Electra			
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Serial #	1380	1438	1354			
Cal. Due Date	10/3/01	2/7/02	1/10/02			
ANALYSIS DATE	8/25/01	8/27/01	8/25/01			
Alpha Bkgd. (cpm)	3.0	3.0	3.0			
Alpha Eff. (c/d)	21.8%	21.10%	21.8%			
Intrument α MDC ($dpm/100cm^2$)	48	48	48			
Beta Bkgd. (cpm)	432	387	470			
Beta Eff. (c/d)	33.50%	31.50%	31.7%			
Intrument β MDC ($dpm/100cm^2$)	318	318	318			

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Survey Area:	CC	Survey Unit:	371003	Building:	T163/164 Berm

Survey Unit/Area Description:

West Product Water Tanks secondary containment. It is approximately 4 feet deep with concrete walls and floor.

Total Surface Activity Data Sheet

Sample Location	Material Type (If Required)	Alpha Total Surface Activity Measurements				Beta-Gamma Total Surface Activity Measurements			
		RCT ID #	Inst. ID #	Gross (cpm)	LAB (cpm)	RCT ID #	Inst. ID #	Gross (cpm)	LAB (cpm)
1	Concrete	4	3	9.3	5.3	4	3	827	647
2		4	3	5.3	5.3	4	3	947	771
3		4	3	12.0	2.7	4	3	988	806
4		4	3	6.0	4.0	4	3	937	819
5		4	3	4.7	6.0	4	3	934	815
6		4	3	6.7	7.3	4	3	933	833
7		4	3	8.0	3.3	4	3	1055	856
8		4	3	5.3	6.0	4	3	859	703
9		3	3	2.0	5.3	3	3	947	857
10		3	3	8.0	4.7	3	3	847	633
11		3	3	5.3	3.3	3	3	946	786
12		3	3	4.0	5.0	3	3	889	724
13		3	3	4.0	4.0	3	3	1031	798
14		3	3	8.0	4.0	3	3	982	791
15	Concrete	3	3	5.3	5.3	3	3	1011	964
16									
17									
18									
19									
20									
3 QC	Concrete	7	1	14.0	3.3	7	1	870	672
1 QC	Concrete	7	1	11.3	4.0	7	1	825	644

Comments:

Direct TSA & background on concrete

COUNT TIME = 90 (SEC)

Note: QC measurements are to be collected with a different instrument than the original survey. Mark the QC location number in the "Sample Location" column.

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Survey Area:	CC	Survey Unit:	371003	Building:	T163/164 Berm

Survey Unit/Area Description:

West Product Water Tanks secondary containment. It is approximately 4 feet deep with concrete walls and floor.

Removable Activity Data Sheet

Location #	RCT ID #	Inst. ID #		Gross counts	
		α	β	α	β
1	1	1	3	1.0	67
2	2	2	4	2.0	57
3	1	1	3	0.0	56
4	2	2	4	1.0	61
5	1	1	3	0.0	63
6	2	2	4	3.0	88
7	1	1	3	0.0	49
8	2	2	4	4.0	76
9	1	1	3	0.0	57
10	2	2	4	0.0	71
11	1	1	3	0.0	74
12	2	2	4	0.0	70
13	1	1	3	0.0	58
14	2	2	4	0.0	84
15	1	2	4	0.0	75
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					

Comments:

All readings from SAC-4 & BC-4 are 2 minute counts

COUNT TIME = 120 **(SEC)**

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Survey Area: CC	Survey Unit: 371003	Building: T163/164 Berm

Survey Unit/Area Description:

West Product Water Tanks secondary containment. It is approximately 4 feet deep with concrete walls and floor.

Scan Survey/Investigation Documentation Formt

Location #	NE Electra Alpha					NE Electra Beta			
	RCT ID #	Inst. ID #	4-sec Audible observed? "Y" or "N"	30-sec Static (gcpm)	90-sec Direct (dpm/100cm^2)	RCT ID #	Inst. ID #	Elevated Audible observed? "Y" or "N"	60-sec Direct (dpm/100cm^2)
M1	1	1	Yes	8					
M2	1	1	Yes	10					
M3	1	1	Yes	10					
M4	1	2	Yes	7					
M5	1	2	Yes	25					
M6	1	1	Yes	4					
M7	1	1	Yes	2					
M8	1	1	Yes	6					
K9	2	2	Yes	14					
K10	2	2	Yes	29					
K11	2	2	Yes	9					
M12	1	1	Yes	4					
K3	2	2	Yes	6					

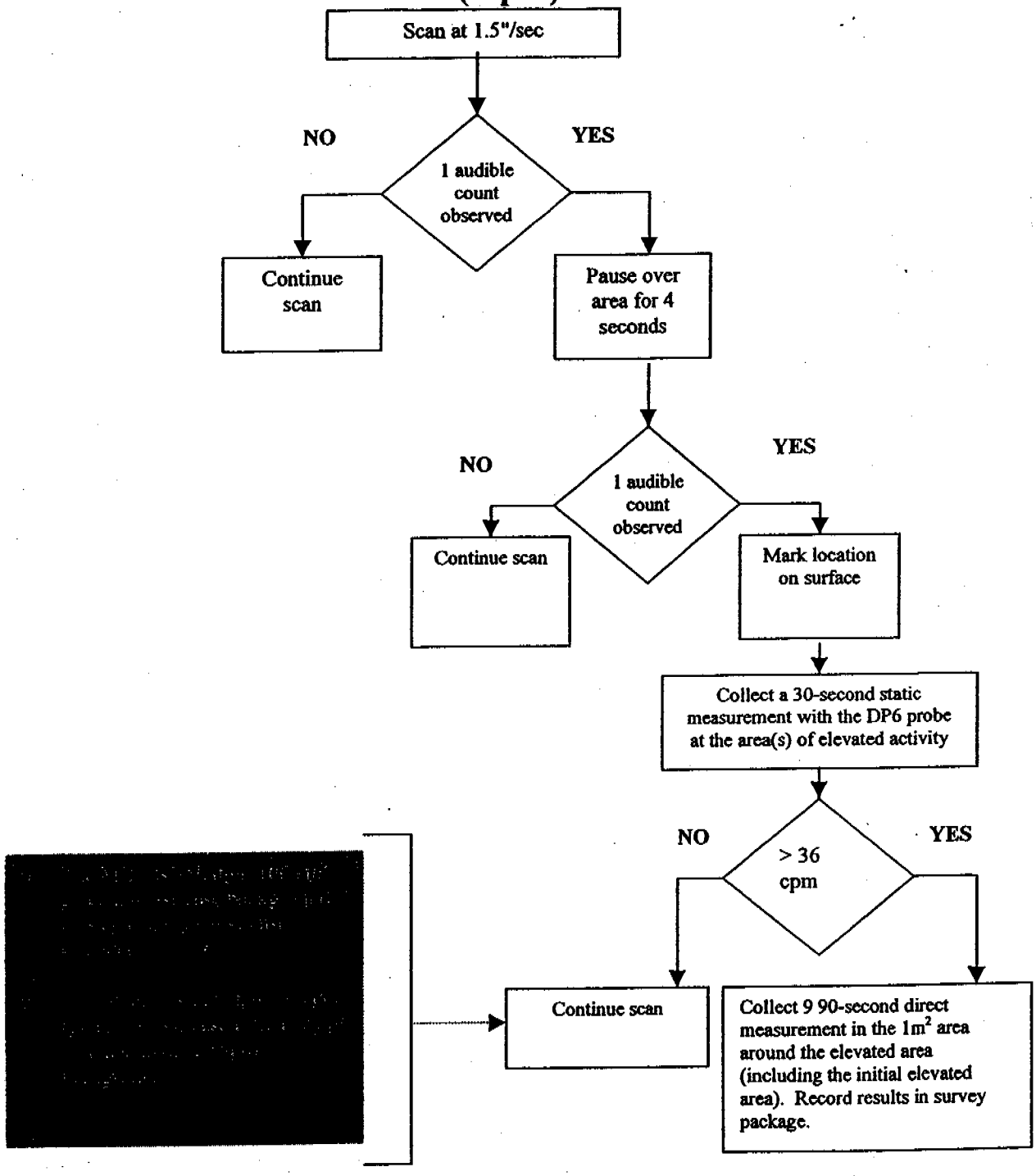
NOTE: Refer to the Instrument Data Sheet and Survey Signature Sheet for instrumentation, surveyor & approval information.

Results/Comments:

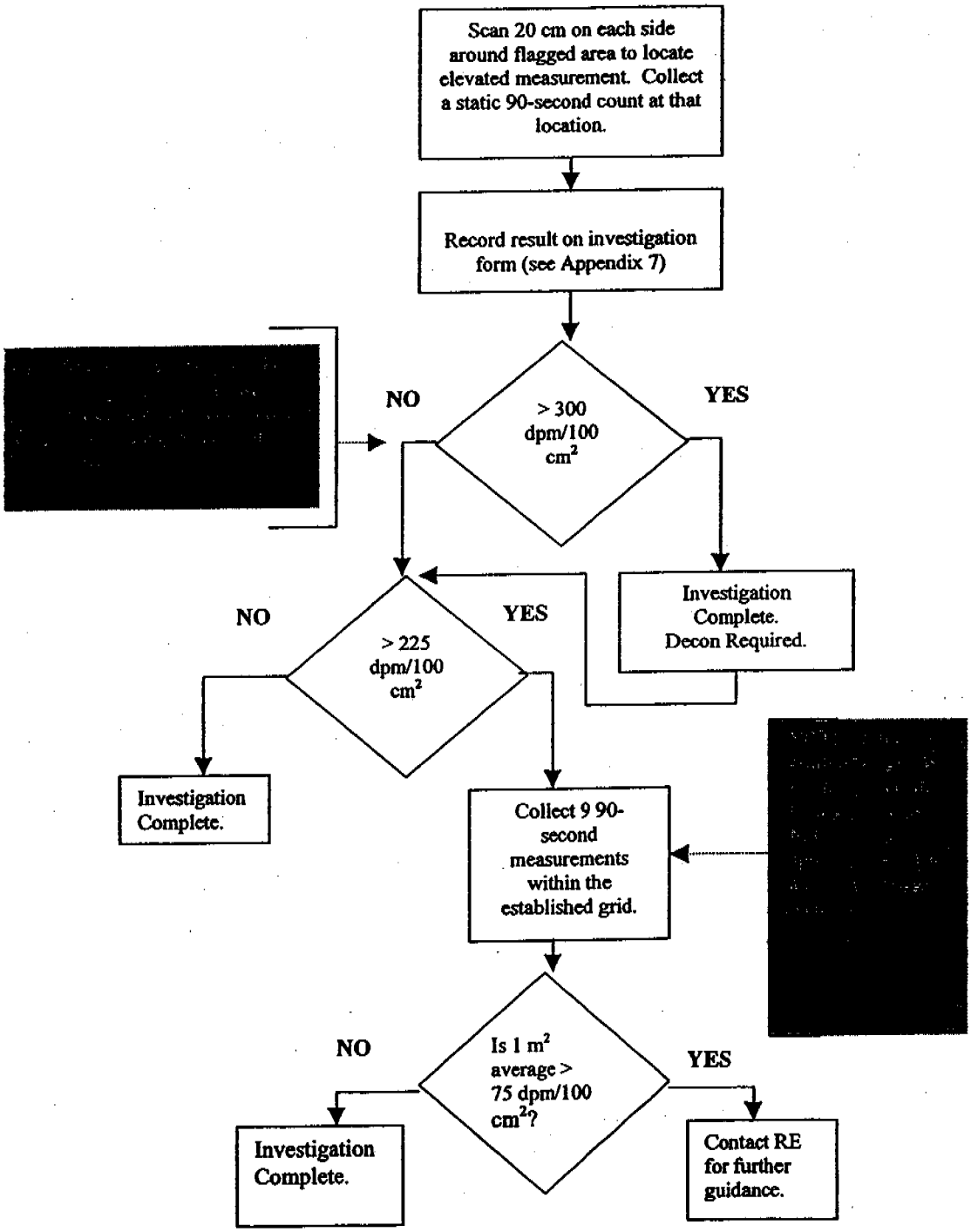
18 m^2 scanned.

No measurements >36 cpm/100cm^2 α.

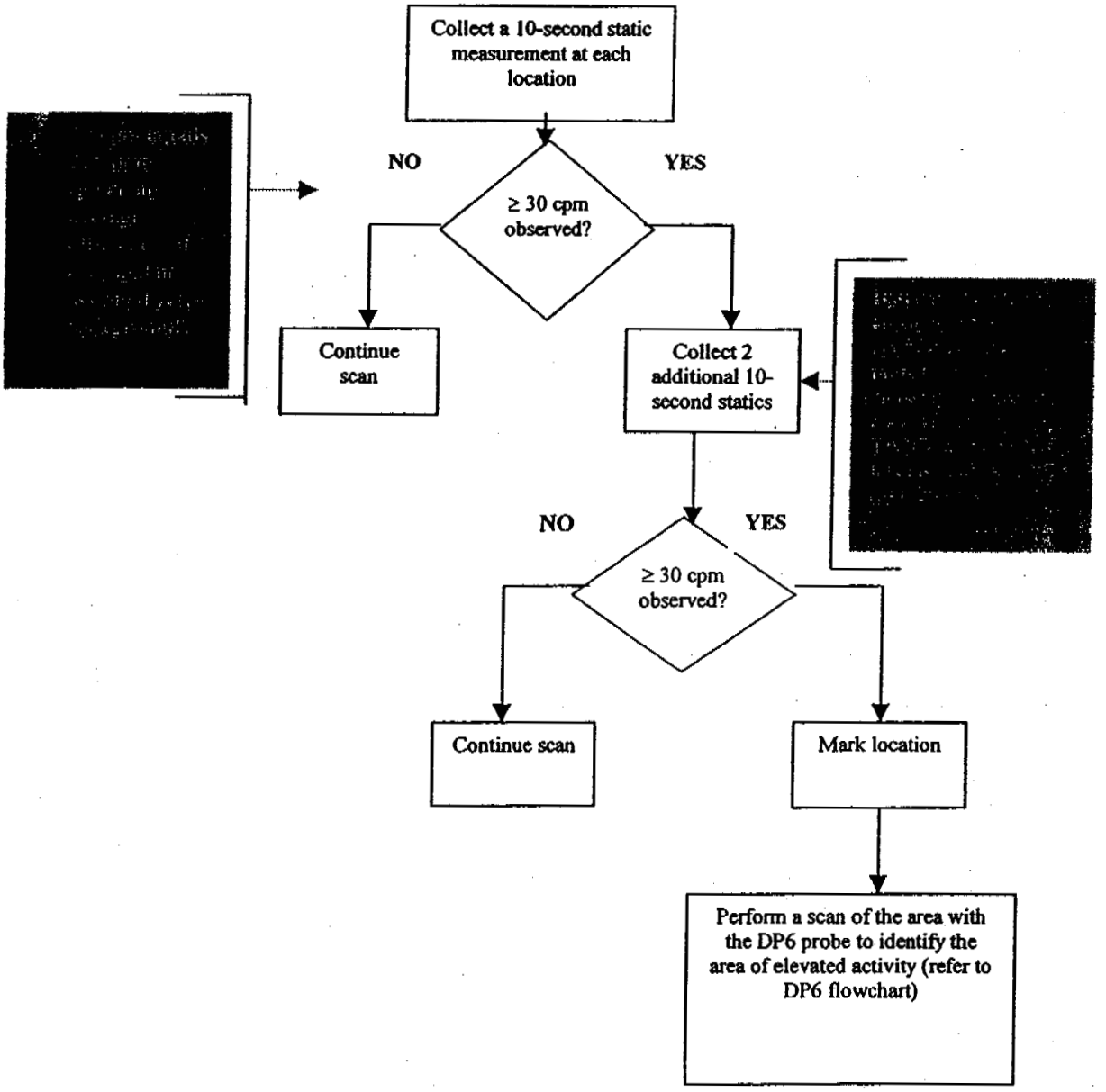
Scan Method with DP6 (example)
(Alpha)



Investigation Method with DP6 (example) (Alpha)



Alpha Scan Method with DP8A or equivalent (example)
Revision 1

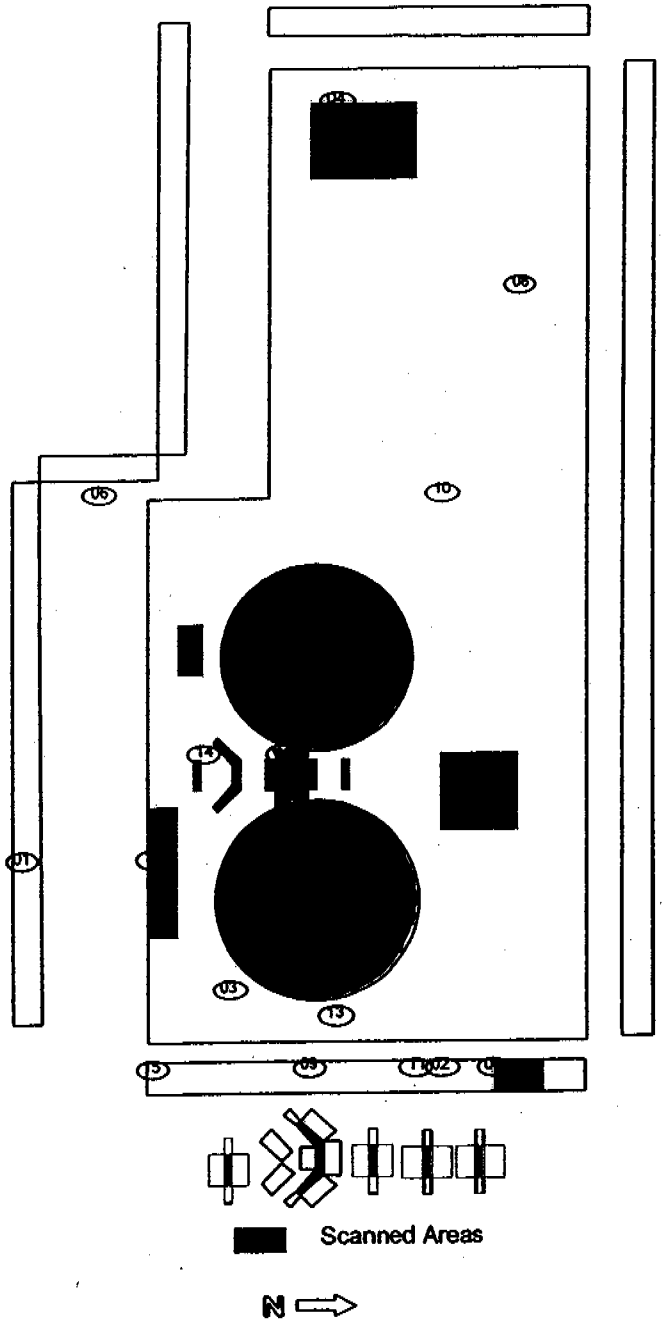


RADIOLOGICAL CLOSEOUT SURVEY FOR

Survey Area: NA **Survey Unit: 371003** **Classification: 3**
Building: 374
Survey Unit Description: T-163/164 Berm

Total Floor Area: NA **Total Area: 598 sq. m** **Grid Size: N/A**

SURVEY UNIT - MAP 1 OF 1



L3

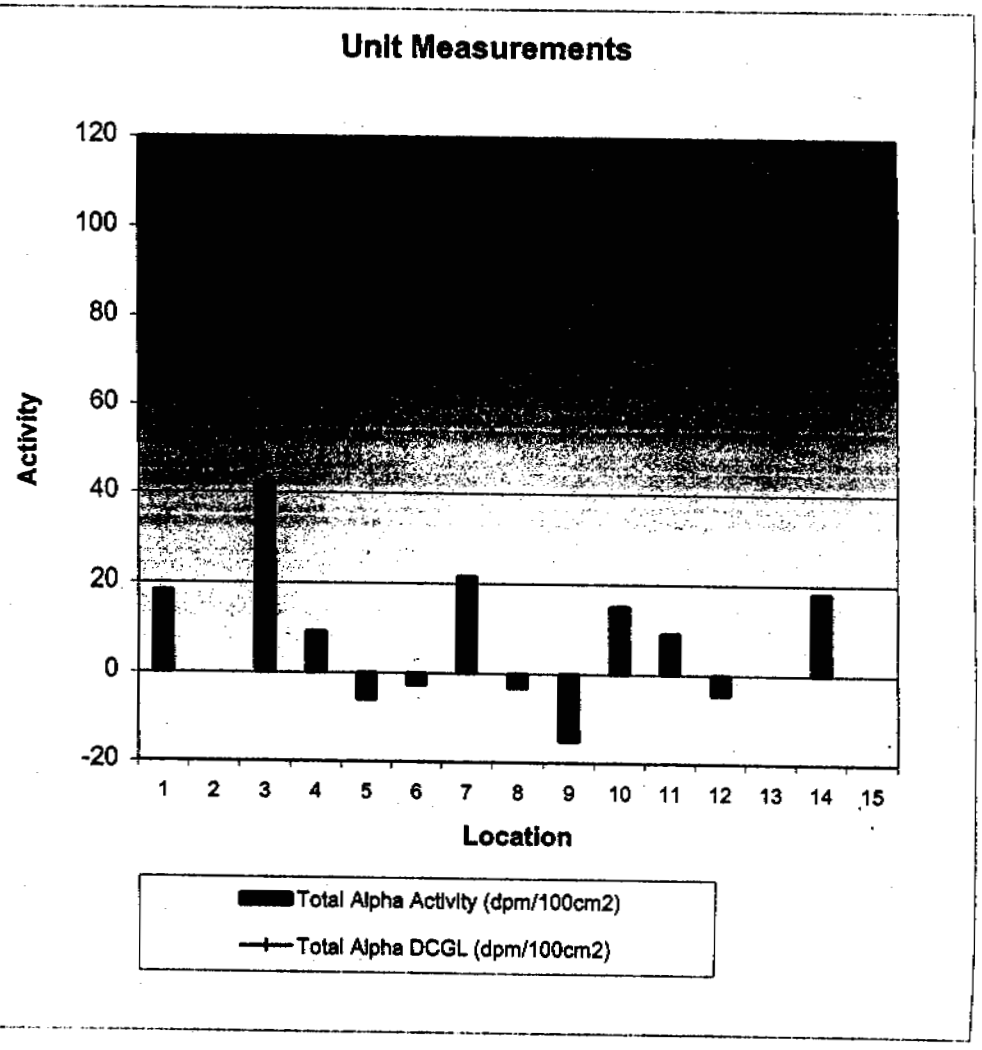
TSA Alpha

371003

8/25/01

				Instument	1380	1438	1354
standard deviation:	14.5	max:	42.7	Ave. Instrument background:	4.8 cpm	4.8 cpm	3.0 cpm
mean:	6.9	min:	-15.1	Instrument efficiency:	21.8%	21.10%	21.80%
median:	0.0			Instrument MDA:	48 dpm	48 dpm	48 dpm

	Surface Location	Total Alpha Counts (cpm/100cm²)	Local Area Bkgd (cpm/100cm²)	Total Alpha Activity (dpm/100cm²)	Total Alpha DCGL (dpm/100cm²)
1	T163/164 Sec. Contm't	9.3	5.3	18.3	100
2	T163/164 Sec. Contm't	5.3	5.3	0.0	100
3	T163/164 Sec. Contm't	12.0	2.7	42.7	100
4	T163/164 Sec. Contm't	6.0	4.0	9.2	100
5	T163/164 Sec. Contm't	4.7	6.0	-6.0	100
6	T163/164 Sec. Contm't	6.7	7.3	-2.8	100
7	T163/164 Sec. Contm't	8.0	3.3	21.6	100
8	T163/164 Sec. Contm't	5.3	6.0	-3.2	100
9	T163/164 Sec. Contm't	2.0	5.3	-15.1	100
10	T163/164 Sec. Contm't	8.0	4.7	15.1	100
11	T163/164 Sec. Contm't	5.3	3.3	9.2	100
12	T163/164 Sec. Contm't	4.0	5.0	-4.6	100
13	T163/164 Sec. Contm't	4.0	4.0	0.0	100
14	T163/164 Sec. Contm't	8.0	4.0	18.3	100
15	T163/164 Sec. Contm't	5.3	5.3	0.0	100
3 QC	T163/164 Sec. Contm't	14.0	3.3	49.1	100
1 QC	T163/164 Sec. Contm't	11.3	4.0	33.5	100



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Total TSA Beta-Gamma

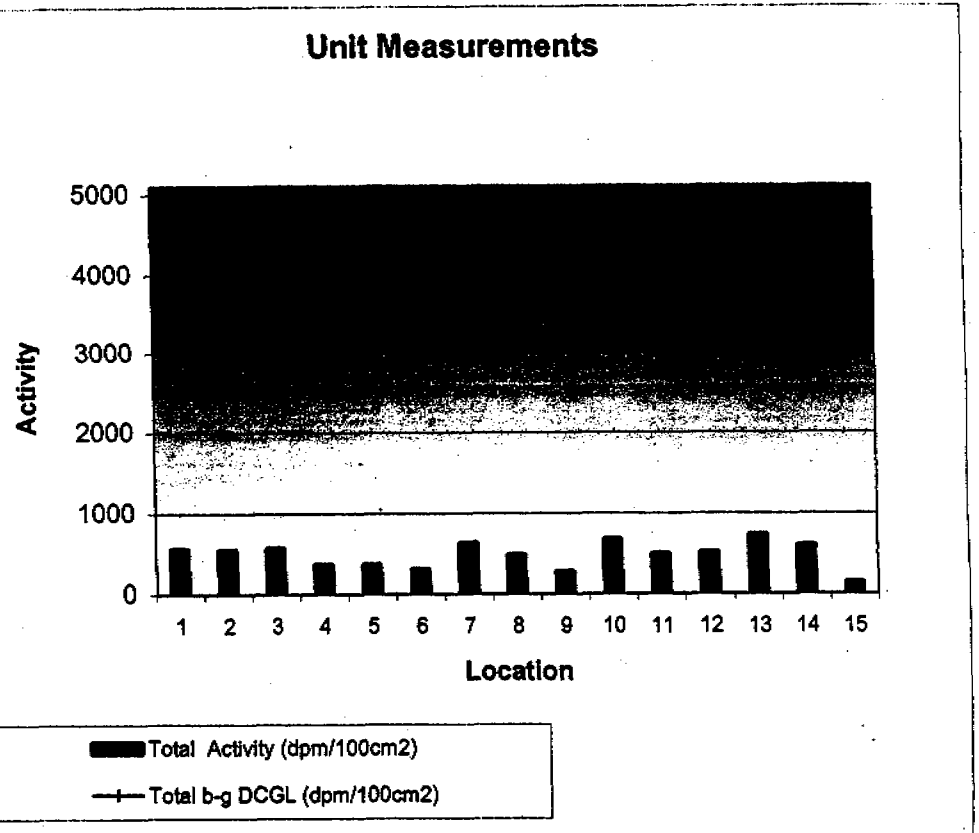
371003

8/25/01

standard deviation:	160.6	max:	735.0
mean:	490.0	min:	148.3
median:	520.5		

Instument	1380	1438	1354
Ave. Instrument background:	786.9 cpm	658.0 cpm	470.0 cpm
Instrument efficiency:	33.5%	31.50%	31.70%
Instrument MDA:	318 dpm	318 dpm	318 dpm

	Surface Location	Total Counts (cpm/100cm²)	Local AreaBkgd (cpm/100cm²)	Total Activity (dpm/100cm²)	Total β–γ DCGL (dpm/100cm²)
1	163/164 Sec. Contm	827.0	647.0	567.8	5000
2	163/164 Sec. Contm	947.0	771.0	555.2	5000
3	163/164 Sec. Contm	988.0	806.0	574.1	5000
4	163/164 Sec. Contm	937.0	819.0	372.2	5000
5	163/164 Sec. Contm	934.0	815.0	375.4	5000
6	163/164 Sec. Contm	933.0	833.0	315.5	5000
7	163/164 Sec. Contm	1055.0	856.0	627.8	5000
8	163/164 Sec. Contm	859.0	703.0	492.1	5000
9	163/164 Sec. Contm	947.0	857.0	283.9	5000
10	163/164 Sec. Contm	847.0	633.0	675.1	5000
11	163/164 Sec. Contm	946.0	786.0	504.7	5000
12	163/164 Sec. Contm	889.0	724.0	520.5	5000
13	163/164 Sec. Contm	1031.0	798.0	735.0	5000
14	163/164 Sec. Contm	982.0	791.0	602.5	5000
15	163/164 Sec. Contm	1011.0	964.0	148.3	5000
3 QC	163/164 Sec. Contm	870.0	672.0	591.0	5000
1 QC	163/164 Sec. Contm	825.0	644.0	540.3	5000



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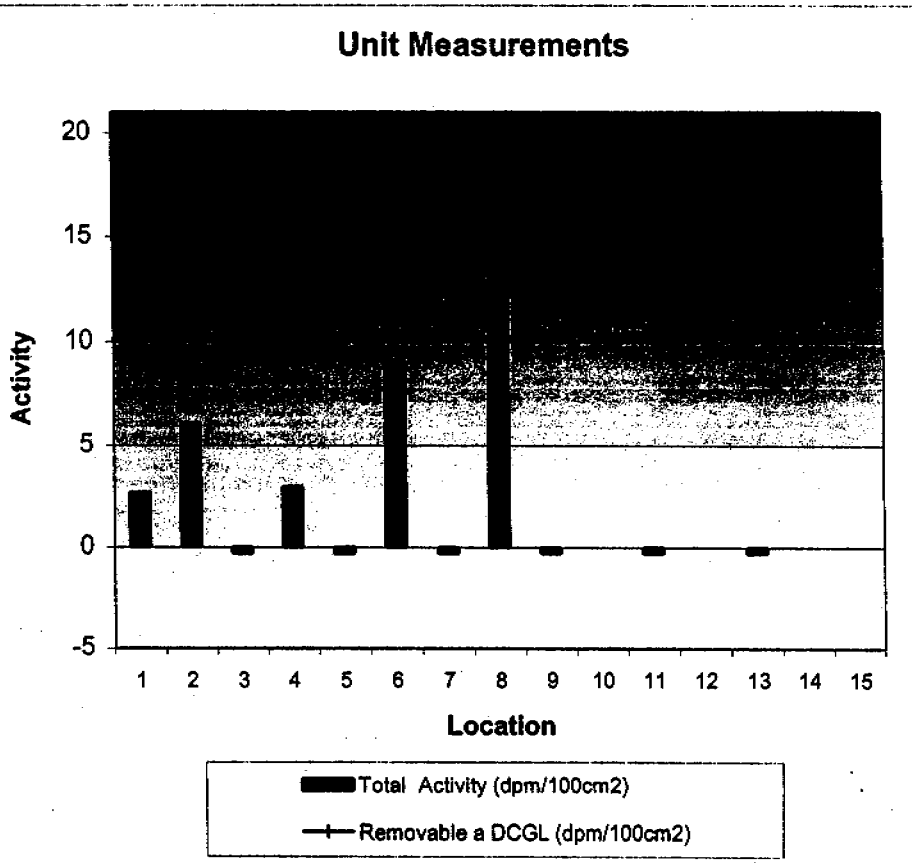
Removable Activity - Alpha

371003

8/25/01

				Instument:	1430	1428
standard deviation:	4.0	max:	12.1	Instrument background:	0.1 cpm	0.6 cpm
mean:	2.1	min:	-0.3	Instrument efficiency:	33.0%	33.0%
median:	0.0			Instrument MDA:	10 dpm	10 dpm

	Surface Location	Total Counts (cpm/100cm²)	Bkgd (cpm/100cm²)	Total Activity (dpm/100cm²)	Removable α DCGL (dpm/100cm²)
1	T163/164 Sec. Contm'	1.0	0.1	2.7	20
2	T163/164Sec. Contm't	2.0	0.0	6.1	20
3	T163/164Sec. Contm't	0.0	0.1	-0.3	20
4	T163/164Sec. Contm't	1.0	0.0	3.0	20
5	T163/164Sec. Contm't	0.0	0.1	-0.3	20
6	T163/164Sec. Contm't	3.0	0.0	9.1	20
7	T163/164 Sec. Contm'	0.0	0.1	-0.3	20
8	T163/164Sec. Contm't	4.0	0.0	12.1	20
9	T163/164Sec. Contm't	0.0	0.1	-0.3	20
10	T163/164Sec. Contm't	0.0	0.0	0.0	20
11	T163/164Sec. Contm't	0.0	0.1	-0.3	20
12	T163/164Sec. Contm't	0.0	0.0	0.0	20
13	T163/164Sec. Contm't	0.0	0.1	-0.3	20
14	T163/164Sec. Contm't	0.0	0.0	0.0	20
15	T163/164Sec. Contm't	0.0	0.0	0.0	20



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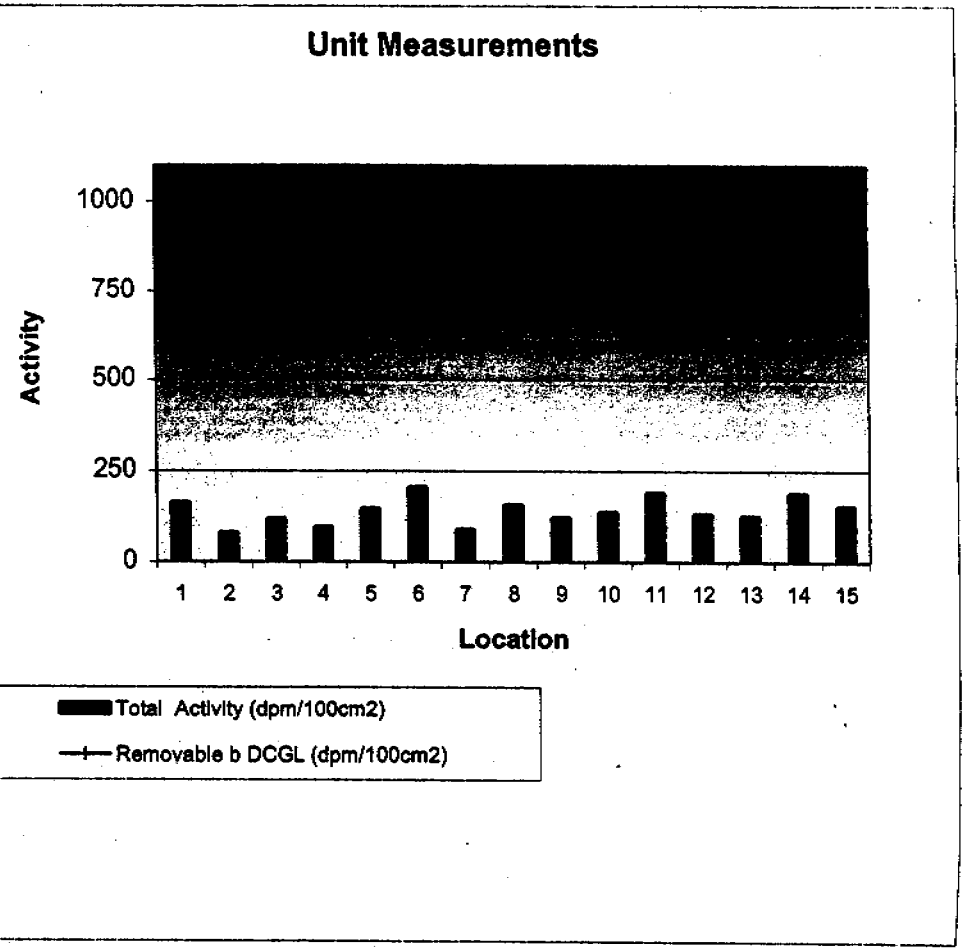
Removable Activity - Beta-Gamma

371003

8/25/01

				Instument:	960	872
standard deviation:	36.8	max:	205.2	Instrument background:	26.3 cpm	36.7 cpm
mean:	140.9	min:	81.2	Instrument efficiency:	25.0%	25.0%
median:	137.2			Instrument MDA:	200 dpm	200 dpm

	Surface Location	Total Counts (cpm/100cm²)	Bkgd (cpm/100cm²)	Total Activity (dpm/100cm²)	Removable β DCGL (dpm/100cm²)
1	'163/164Sec. Contm'	67.0	26.3	162.8	1000
2	'163/164Sec. Contm'	57.0	36.7	81.2	1000
3	'163/164Sec. Contm'	56.0	26.3	118.8	1000
4	'163/164Sec. Contm'	61.0	36.7	97.2	1000
5	'163/164Sec. Contm'	63.0	26.3	146.8	1000
6	'163/164Sec. Contm'	88.0	36.7	205.2	1000
7	'163/164Sec. Contm'	49.0	26.3	90.8	1000
8	'163/164Sec. Contm'	76.0	36.7	157.2	1000
9	'163/164Sec. Contm'	57.0	26.3	122.8	1000
10	'163/164Sec. Contm'	71.0	36.7	137.2	1000
11	'163/164Sec. Contm'	74.0	26.3	190.8	1000
12	'163/164Sec. Contm'	70.0	36.7	133.2	1000
13	'163/164Sec. Contm'	58.0	26.3	126.8	1000
14	'163/164Sec. Contm'	84.0	36.7	189.2	1000
15	'163/164Sec. Contm'	75.0	36.7	153.2	1000
16					
17					



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SURVEY UNIT
371004

SURVEY PACKAGE COVER SHEET

Survey Area: CC	Survey Unit: 371004	Building/Structure: T165,167,168,169

Survey Unit/Area Description:
Tank 165 (concrete silo), Tank 167 (nitric acid), and Tanks 168 & 169 (potassium hydoxide).

Building Information:

Survey Type: Reconnaissance Level Characterization Survey ☐ Pre-Demolition Survey ☑

Building Type: Type 1 ☑ Type 2 ☐ Type 3 ☐

Classification: Class 1 ☐ Class 2 ☐ Class 3 ☑ Unknown ☐

Contaminants of Concern: Plutonium ☑ Uranium ☑ Other ☐

Justification for Classification: No history of radiological operations or material storage. Areas not expected to contain any residual radioactivity greater than $DCGL_w$. No individual measurements are expected to exceed the indicated value.

Special Support Requirements: None.

Special Safety Requirements: Survey personnel shall be trained for ladder safety.

Isolation Controls:
LEVEL 1 ☐ LEVEL 2 ☑ N/A ☐

No use, storage, or movement of radioactive material, with the exception of instrument check sources, is permitted in this survey unit.

Labeling Requirements: Survey locations are identified as indicated on the attached survey unit map(s). Survey location numbers will be annotated at each survey location.

Survey Package Implementation:

D. A. Barnes			8/23/01
Radiological Engineer Printed Name	Employee #	Radiological Engineer Signature	Date
Larry Rands			8/23/01
Radiological Engineer Printed Name	Employee #	Radiological Engineer Signature	Date

Comments:

Survey Package Closure:

Radiological Engineer Printed Name	Employee #	Radiological Engineer Signature	Date
Radiological Engineer (Peer Review) Printed Name	Employee #	Radiological Engineer (Peer Review) Signature	Date
RE Manager or RSM Printed Name	Employee #	RE Manager or RSM Signature	Date

(PRO-475-RSP-16.01, effective 05/22/01)

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SURVEY PACKAGE TRACKING FORM

Survey Area:	Survey Unit:	Initiator/ Date	Release Date	Validation Date	Closure Date
CC	371004				

(PRO-475-RSP-16.01, effective 05/22/01)

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SURVEY PACKAGE CORRECTION/CHANGE HISTORY FORM

Survey Area:	CC	Survey Unit:	371003	Building/Structure:	T163/164 Berm

Change #	Description	Initiator/ Date	RE
1	Changed "Pre" & "Post" to "Alpha" & "Beta" on page 10.	Barnes/8-24-01	
2	Changed Calculation Worksheet Package ID to "371 N Side Project - T163 & 164 berm".	Barnes/9-4-01	

(PRO-475-RSP-16.01, effective 05/22/01)

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SURVEY PACKAGE SURVEY/SAMPLING INSTRUCTION FORM

Survey Area:	CC	Survey Unit:	371004	Building/Structure:	T165,167,168,169

Survey Unit/Area Description:

Tank 165 (concrete silo), Tank 167 (nitric acid), and Tanks 168 & 169 (potassium hydoxide).

Minimum Survey/Sampling Measurement Requirements

Measurement	Number and Type	Comments
Surface Activity Measurements	**TOTAL SURFACE CONTAMINATION** 15 – Alpha & Beta-Gamma **REMOVABLE SURFACE CONTAMINATION** 15 – Alpha & Beta-Gamma	90-second count time required 2-minute count time required Note: All locations are denoted on survey package survey map.

RE Verification	D. A. Barnes			8/23/01
	Print Name	Employee #	Signature	Date

Surface Scanning	Alpha & Beta-Gamma scans at 3% of accessible surfaces at biased locations (i.e., doorways, lower walls, floors, etc.)	Refer to attached flowchart for scanning instructions with DP6 probe.

RE Verification	D. A. Barnes			8/23/01
	Print Name	Employee #	Signature	Date

Media Samples	One surface media sample is required on the south side, bottom exterior of Tank 168 due to an elevated RLC α TSA measurement.	See project Radiological Engineer for precise sample location. Perform pre-sampling and post-sampling surveys of sample location.

RE Verification	D. A. Barnes			8/23/01
	Print Name	Employee #	Signature	Date

Survey Area:	CC	Survey Unit:	371004	Building/Structure:	T165,167,168,169

Survey Unit/Area Description:

Tank 165 (concrete silo), Tank 167 (nitric acid), and Tanks 168 & 169 (potassium hydoxide).

Survey/Sampling Instructions

- **NOTE:** Any changes to the Survey Package must be logged in the "Survey Package Corrections/Change History Form."
- **RCT** – If not already completed, label the survey unit surfaces per the Survey Package Cover Sheet Grid Requirements Section and the attached survey map(s).
- **RCT** – If not already completed, transpose sample numbers from attached survey maps onto each corresponding survey location on the survey unit surfaces.
- **RCT** – Perform pre-use performance checks of all instrumentation to be utilized in conjunction with this survey package. *A priori* Minimum Detectable Concentrations (MDCs) listed in the RFETS Pre-Demolition Survey Plan (PDSP) may be used. If MDCs are calculated, use the formula indicated below in the sampling instructions. Verify that computed MDCs are less than 50% of the applicable $DCGL_W$. Record all information on the Instrument Data Sheet.
- **RCT** – When calculating MDC values for smears and static field measurements, use the following equation:

$$MDC = \frac{3 + 3.29\sqrt{R_b t_s (1 + \frac{t_s}{t_b})}}{E_t (A/100) t_s}$$

Where,

R_b = Background counting rate
t_s = sample counting time interval
t_b = background counting time
E_t = total efficiency
A = physical surface area of the detector (or area sampled for smears)

Note: Ensure that a 90 second count time is utilized when determining the MDC of the NE Electra. A ten minute background and a two minute sample count time shall be used for the SAC-4. This will allow a correspondence between the MDC calculations and field measurements.

Note: Perform TSA (first) background (second), and removable measurements (third), at a location to the right of the sample location labels. If this area is not accessible, then move in a clockwise direction of the sample location label until a suitable location is revealed. DO NOT perform TSA and removable surveys on the sample location sticker itself.

- **RCT** – Obtain a local area background measurement using a shielded probe (¾ inch slab of wood that will be provided) or by turning the probe to face away from the surface being measured. Local Area Background values should be obtained at each TSA measurement location just AFTER obtaining the actual total surface activity. Place the probe shield at the same location the field measurement is to be taken and record the actual background reading (cpm) on the appropriate form.

Survey Area:	CC	Survey Unit:	371004	Building/Structure:	T165,167,168,169

Survey Unit/Area Description:

Tank 165 (concrete silo), Tank 167 (nitric acid), and Tanks 168 & 169 (potassium hydoxide).

Survey/Sampling Instructions

- **RCT** - Obtain 100cm^2 total surface activity measurements (and local area background measurements) at each labeled measurement location per 3-PRO-476-RSP 16.02, Radiological Surveys of Surfaces and Structures. Record the results on the "Total Surface Activity Data Sheet".

- **RCT** - Obtain 100cm^2 removable smears at each labeled measurement per 3-PRO-476-RSP 16.02, Radiological Surveys of Surfaces and Structures. Record the results on the "Removable Contamination Data Sheet". Ensure that a background count time of 10 minutes and a sample count time of 2 minutes is used.

- **RCT** – perform Scans and investigation scans (if applicable) as described on attached flowchart. Complete the "Scan and Investigation Data Sheet" as appropriate.

  Note (NE Electra): Given the total alpha contamination action level of 225 dpm/100 cm^2 (75% of $DCGL_{EMC}$), and a probability of detection of 67%, the appropriate scan rate for alpha measurements is 1.5 in/s (~3.81 cm/s). Upon initial detection of a single count, the surveyor should pause over the area for 4 seconds. If one or more counts is observed in that time interval (equivalent to 15 cpm on NE Electra display), the surveyor should perform a 30-second TSA on the area (Refer to Investigation Flowchart for additional guidance).

  Note (Radhound Final Survey Monitor): If the $DCGL_{EMC}$ investigation limit (225 dpm/100 cm^2) is exceeded / detected, then RCT shall perform investigation with the NE Electra in accordance with attached flowchart. Radhound Final Survey Monitor scan rates are determined utilizing incorporated software in the field (see Radhound Manual for technical basis). Areas to be scanned shall be marked to include grid location corners, at a minimum, to confirm measurement locations are traceable.

- **RCT** – When values are less than the Minimum Detectable Concentration (MDC), the actual value shall be annotated on the survey form.

- **RCT** – In the event any removable measurement exceeds 20 dpm/100cm^2 alpha, any total activity measurement exceeds 100 dpm/100cm^2 alpha, or any scan measurement exceeds 225 dpm/100cm^2 alpha, notify the cognizant Radiological Engineer. Radiological Engineering will evaluate to determine if the elevated reading represents actual DOE-added material, NORM, or statistical anomalies prior to any decision-making process or additional investigation methods.

- **RCT** - Collect QC measurements (90 sec., TSA only) at a frequency of 5% of the total number of initial measurement locations (minimum of 2 per survey unit). Do not collect measurements at locations of zero or negative initial results. QC measurements are to be collected with a different instrument and by a different technician than the original survey.

- **RCT** – Complete the attached "Instrument Data Sheet" for all instrumentation used for this final survey.

- **RCT** – Complete the attached "Survey Signature Sheet" and forward the survey package to the RCT Foreman for review.

- **RCT** - Perform post-use performance checks immediately following use, typically following the conclusion of measurements on the same day. The post-use performance checks SHALL fall within ± 20% of the established range to be considered acceptable.

- **RCT Supervisor** – Review the applicable forms in the survey package for completeness, complete the attached "Survey Package Validation Checklist Form" and the "Survey Signature Sheet," and forward the survey package to Characterization Radiological Engineering for final disposition.

SURVEY PACKAGE CALCULATION WORKSHEET

371 N. SIDE PROJECT

Package ID:	~~Bldg 865 cluster exteriors~~ 9-4-01	**Building:**	T165,167,168,169
Survey Area:	CC	**Survey Unit:**	371004

Survey Unit/Area Description:
Tank 165 (concrete silo), Tank 167 (nitric acid), and Tanks 168 & 169 (potassium hydoxide).

☑	**Total Surface Activity**	☐	**Media Surface Activity**
☑	**Removable Surface Activity**	☐	**Volumetric Activity**

Step 1: Calculate the relative shift Δ/σ_s.
$\Delta/\sigma_s = (DCGL-LBGR)/\sigma_s$
$\Delta/\sigma_s =$

where:
- Δ/σ_s is the relative shift or the resolution of measurements in units of measurement uncertainty (MARSSIM recommends a value between 1 and 3).
- DCGL is the total surface activity derived concentration guideline value (DOE Order 5400.5 total surface activity limit equals 100 dpm/100cm^2 for transuranics)
- LBGR is the lower bound of the gray region - the lower bound of the range of values of the parameter of interest in a survey unit where the consequences of making a decision error is relatively minor. The LBGR TSA was adjusted to obtain a relative shift between 1 and 3 (i.e.. 40 dpm/100cm^2 for transuranics).
- σ_s is the estimated standard deviation of the total surface activity measurements (MARSSIM recommends assuming a 30% coefficient of variation if scoping or characterization data is not available)

Step 2: Determine Sign p using the calculated relative shift and Table 4. Sign p is the estimated probability that a random measurement from the survey unit will be less than the $DCGL_w$ when the survey unit median is actually at the LBGR.

Step 3: Determine Decision Error Percentiles for Z1-α and Z1-β and the selected decision error levels α and . Typical (α) and (β) values used at RFETS are 0.05 and 0.05 respectively. This yields a Z1-α and Z1-β value of 1.645 and 1.645 respectively.

Step 4: Calculate Number of Data Points (N) for Sign Test using the following equation:

$$N = \frac{(Z_{1-\alpha} + Z_{1-\beta})^2}{4(Sign\,p - 0.5)^2}$$

$N = (1.645 + 1.645)^2 / 4(\text{Sign p} - 0.5)^2$
$N = (1.645 + 1.645)^2 / 4(0.977250-0.5)^2 = 11.88$

where:
- 1.645 is the alpha and beta decision error value (95% confidence) per the PDSP.
- Sign p equals 0.977250

Step 4: Increase N by 20% to allow for missing or invalid data points per MARSSIM, Section 5.5.2.3.
$N = 11.88 * 1.2 = 14.25$

Step 5: Increase the number of data points by 20% to ensure sufficient power of the tests and to allow for possible data losses.

Conclusion: A minimum of 15 Total Surface and Removable Activity measurements will required for each survey unit.

D. A. Barnes			8/23/01
RE Printed Name	Employee #	Radiological Engineer Signature	Date
Larry Rands			8/23/01
RE (Peer Review) Print Name	Employee #	Radiological Engineer Signature	Date

Survey Area: CC	Survey Unit: 371004	Building: T165,167,168,169

Survey Unit/Area Description:

Tank 165 (concrete silo), Tank 167 (nitric acid), and Tanks 168 & 169 (potassium hydoxide).

SURVEY SIGNATURE SHEET

REMOVABLE/TOTAL SURFACE ACTIVITY/SCAN SURVEYS PERFORMED BY

	RCT Printed Name	Employee #	RCT Signature	Date
RCT ID # 1	WM Krueger		WM Krueger	8-28-01
RCT ID # 2	Marcus Chase		Marcus Chase	8-28-01
RCT ID # 3	Kieven Parks		Kieven Parks	8-28-01
RCT ID # 4				
RCT ID # 5				
RCT ID # 6				

Quality Control Measurements Performed By

	RCT Printed Name	Employee #	RCT Signature	Date
RCT ID # 7	Marcus Chase		Marcus Chase	8-28-01
RCT ID # 8				
RCT ID # 9				
RCT ID # 10				

Survey Reviewed By

RCT Supervision Printed Name	Employee #	RCT Supervision Signature	Date
R. T. Ruffin		RT Ruffin	8-28-01

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Survey Area:	CC	Survey Unit:	371004	Building:	T165,167,168,169

Survey Unit/Area Description:

Tank 165 (concrete silo), Tank 167 (nitric acid), and Tanks 168 & 169 (potassium hydoxide).

INSTRUMENT DATA SHEET

Removable Activity Survey Instrument Data

Manufacturer	Eberlinee	Eberline	Eberline	Eberline		
Model	SAC-4	SAC-4	BC-4	BC-4		
Inst. ID #						
Serial #	1428	1430	960	872		
Cal. Due Date	2/11/02	11/3/01	8/31/01	7/26/02		
ANALYSIS DATE	8/25/01	8/25/01	8/25/01	8/25/01		
Alpha Bkgd. (cpm)	0.6	0.2				
Alpha Eff. (c/d)	33.0%	33.0%				
Intrument α MDC (dpm/100cm^2)	10.0	10.0				
Beta Bkgd. (cpm)			26.3	33.9		
Beta Eff. (c/d)			25.0%	25.0%		
Intrument β MDC (dpm/100cm^2)			200	200		

Total Surface Activity Instrument Data

Manufacturer	NE	NE	NE	NE	NE	
Model	Electra	Electra	Electra	Electra	Electra	
Inst. ID #						
Serial #	2146	1380	1526	1526	1508	
Cal. Due Date	11/14/01	10/3/01	1/11/02	1/11/02	1/25/02	
ANALYSIS DATE	8/26/01	8/26/01	8/26/01	8/29/01	9/12/01	
Alpha Bkgd. (cpm)	1.0	2.0	2.0	0.0	3.0	
Alpha Eff. (c/d)	22.1%	21.8%	21.1%	21.1%	20.5%	
Intrument α MDC (dpm/100cm^2)	48	48	48	48	48	
Beta Bkgd. (cpm)	406	410	365			
Beta Eff. (c/d)	33.90%	33.50%	29.8%			
Intrument β MDC (dpm/100cm^2)	318	318	318			

(PRO-475-RSP-16.01, effective 05/22/01)

Survey Area: CC	Survey Unit: 371004	Building: T165,167,168,169

Survey Unit/Area Description:
Tank 165 (concrete silo), Tank 167 (nitric acid), and Tanks 168 & 169 (potassium hydoxide).

Total Surface Activity Data Sheet

Sample Location	Material Type (If Required)	Alpha Total Surface Activity Measurements				Beta-Gamma Total Surface Activity Measurements			
		RCT ID #	Inst. ID #	Gross (cpm)	LAB (cpm)	RCT ID #	Inst. ID #	Gross (cpm)	LAB (cpm)
1	Tanks	3	2	4.0	9.3	3	2	385	549
2		2	2	10.0	4.0	2	2	356	449
3		3	2	11.3	6.7	3	2	392	399
4		2	2	13.3	10.0	2	2	303	332
5		3	2	2.7	4.7	3	2	614	604
6		2	2	2.0	4.7	2	2	446	446
7		3	2	24.7	4.0	3	2	437	427
8		2	2	12.0	2.0	2	2	735	610
9		3	2	17.3	8.7	3	2	343	343
10		2	2	5.3	3.3	2	2	345	377
11		3	2	6.7	7.3	3	2	347	388
12		2	2	2.0	4.0	2	2	423	437
13		1	2	5.3	6.7	3	2	317	362
14	▼	1	2	20.0	5.3	2	2	477	417
15	Tanks	1	2	6.7	10.0	3	2	345	379
16									
17									
18									
19									
20									
7 QC	Tanks	7	3	24.7	2.0	7	3	426	377
14 QC	Tanks	7	3	13.3	2.7	7	3	346	296

Comments:

COUNT TIME = 90 (SEC)

Note: QC measurements are to be collected with a different instrument than the original survey. Mark the QC location number in the "Sample Location" column.

Survey Area:	CC	Survey Unit:	371004	Building:	T165,167,168,169

Survey Unit/Area Description:

Tank 165 (concrete silo), Tank 167 (nitric acid), and Tanks 168 & 169 (potassium hydoxide).

Removable Activity Data Sheet

Location #	RCT ID #	Inst. ID #		Gross counts	
		α	β	α	β
1	2	2	3	0.0	74
2	3	1	4	1.0	74
3	2	2	3	0.0	66
4	3	1	4	0.0	68
5	2	2	3	1.0	75
6	3	1	4	0.0	69
7	2	2	3	1.0	39
8	3	1	4	0.0	63
9	2	2	3	1.0	57
10	3	1	4	0.0	51
11	2	2	3	1.0	71
12	3	1	4	1.0	64
13	2	2	3	1.0	77
14	3	1	4	0.0	68
15	2	2	3	0.0	68
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					

Comments:

All readings from SAC-4 & BC-4 are 2 minute counts

COUNT TIME = 120 (SEC)

Survey Area: CC	Survey Unit: 371004	Building: T165,167,168,169

Survey Unit/Area Description:

Tank 165 (concrete silo), Tank 167 (nitric acid), and Tanks 168 & 169 (potassium hydoxide).

Scan Survey/Investigation Documentation Form

Location #	NE Electra Alpha					NE Electra Beta			
	RCT ID #	Inst. ID #	4-sec Audible observed? "Y" or "N"	30-sec Static (gcpm)	90-sec Direct (dpm/100cm^2)	RCT ID #	Inst. ID #	Elevated Audible observed? "Y" or "N"	60-sec Direct (dpm/100cm^2)
W1	1	1	Yes	11					
W2	1	1	Yes	10					
W3	1	1	Yes	8					
W4	1	1	Yes	8					
W5	1	1	Yes	14					
W6	1	1	Yes	10					
W7	1	1	Yes	24					
W8	1	1	Yes	34					
W9	1	1	Yes	20					
W10	1	1	Yes	40	154.0				
W11	1	1	Yes	24					
W12	1	1	Yes	8					
M13	2	3	Yes	16					
M14	2	3	Yes	10					
M15	2	3	Yes	12					
M16	2	3	Yes	10					
M17	2	3	Yes	12					
M18	2	3	Yes	16					
07	3	3	NA	NA	107.6				

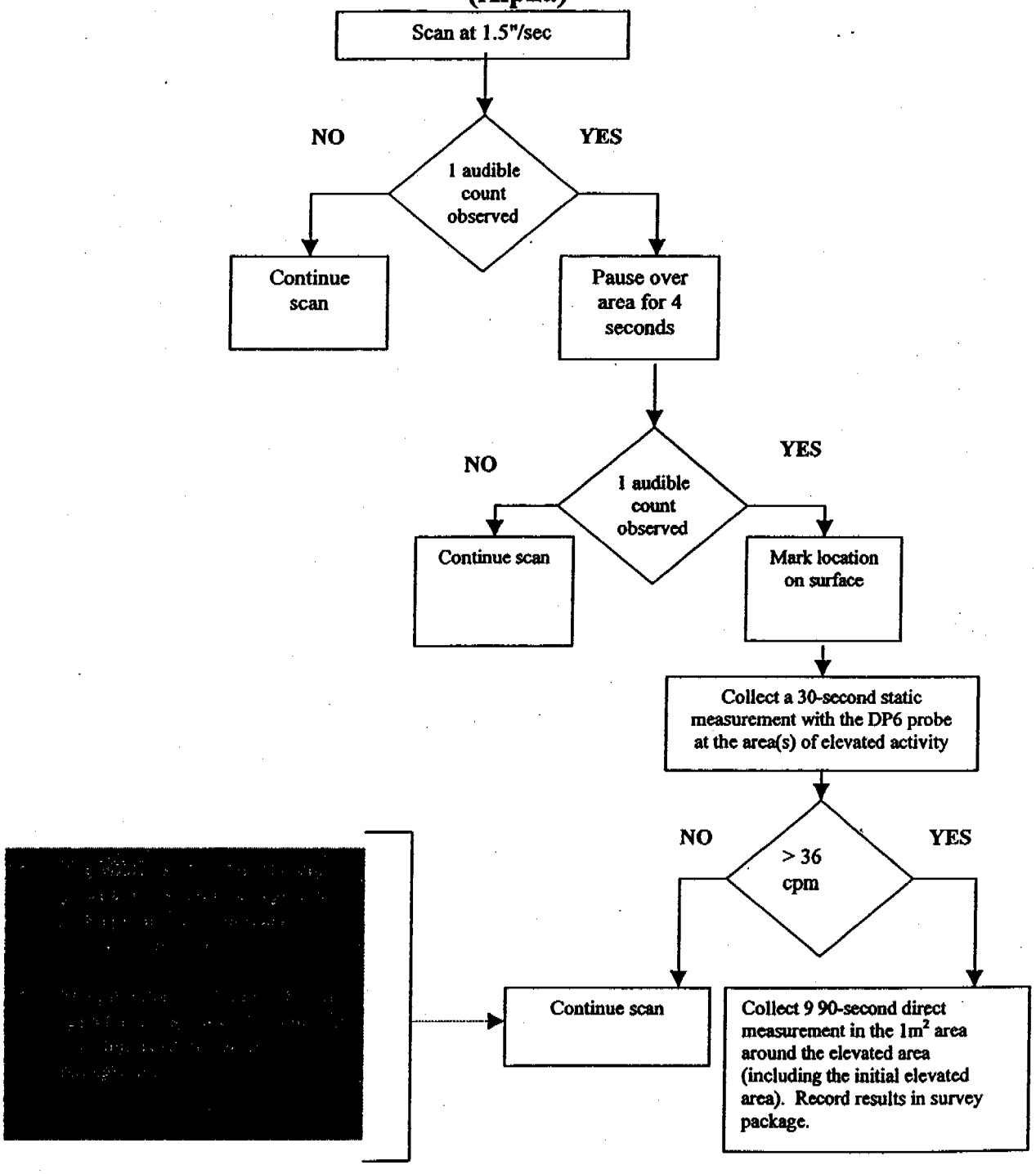
NOTE: Refer to the Instrument Data Sheet and Survey Signature Sheet for instrumentation, surveyor & approval information.

Results/Comments:

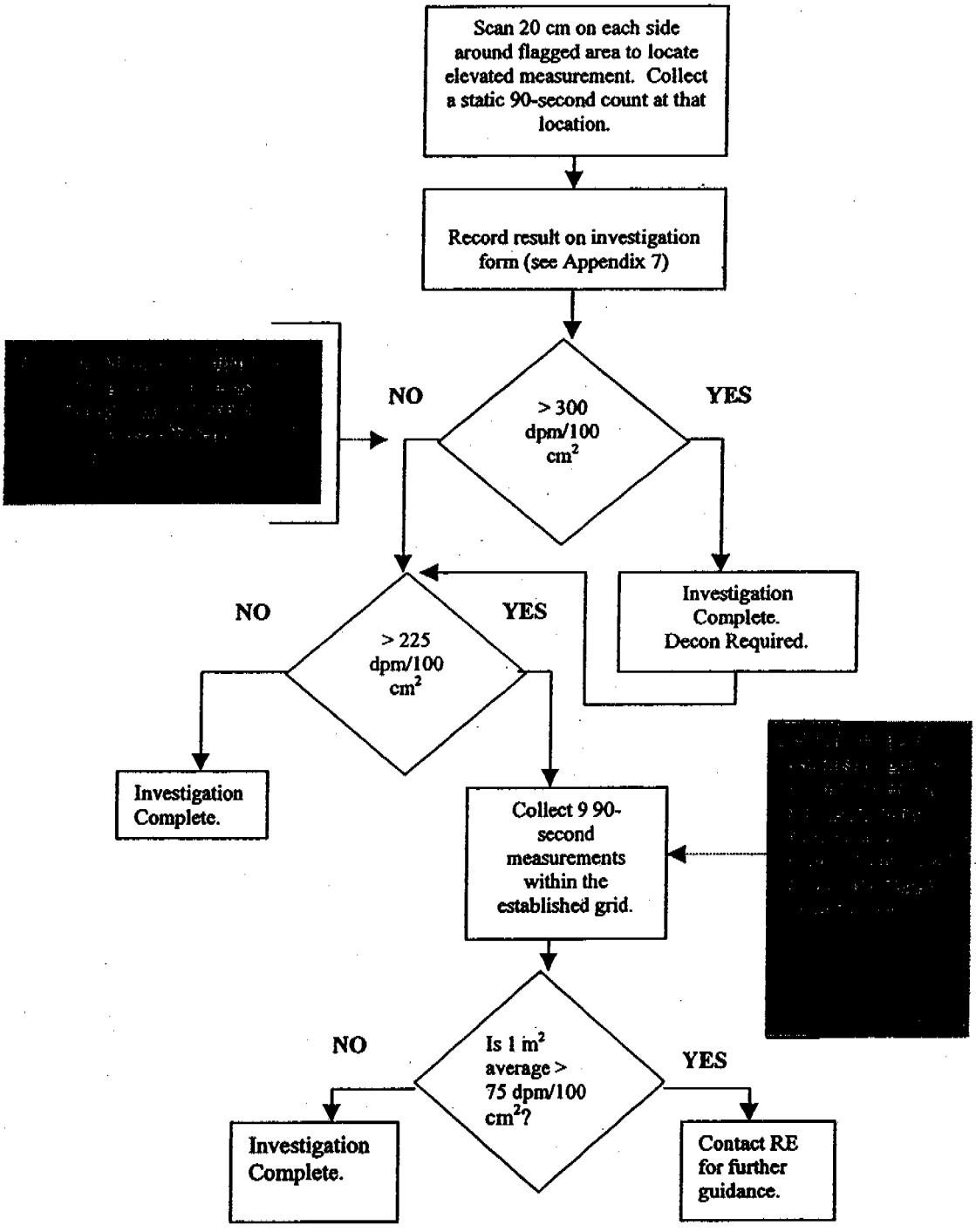
3% of surface area.

Scan 16.08 m^2.

Scan Method with DP6 (example)
(Alpha)



Investigation Method with DP6 (example) (Alpha)



(PRO-475-RSP-16.01, effective 05/22/01)

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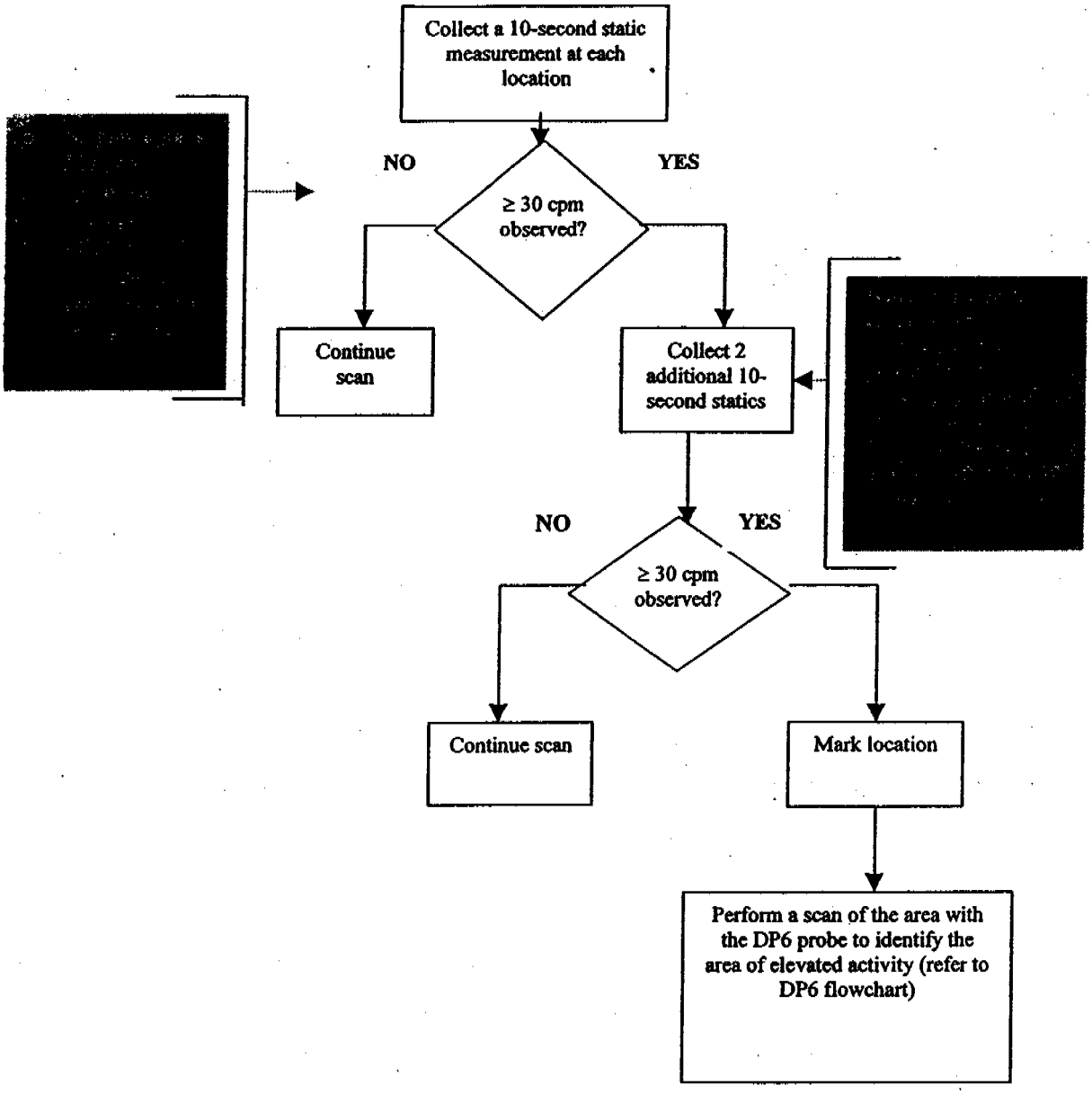
Alpha Scan Method with DP8A or equivalent (example)
Revision 1



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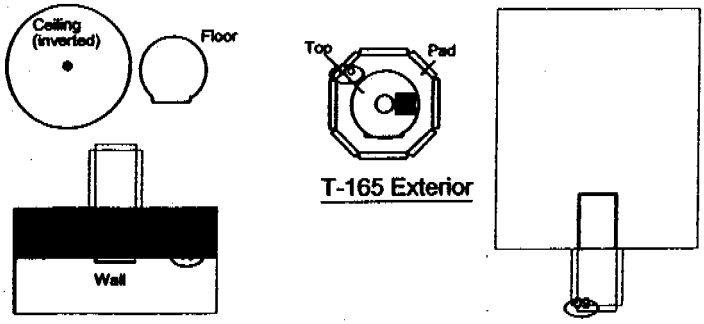
RADIOLOGICAL CLOSEOUT SURVEY FOR

Survey Area: NA **Survey Unit: 371004** **Classification: 3**
Building: 374
Survey Unit Description: T- 165, 167, 168, 169

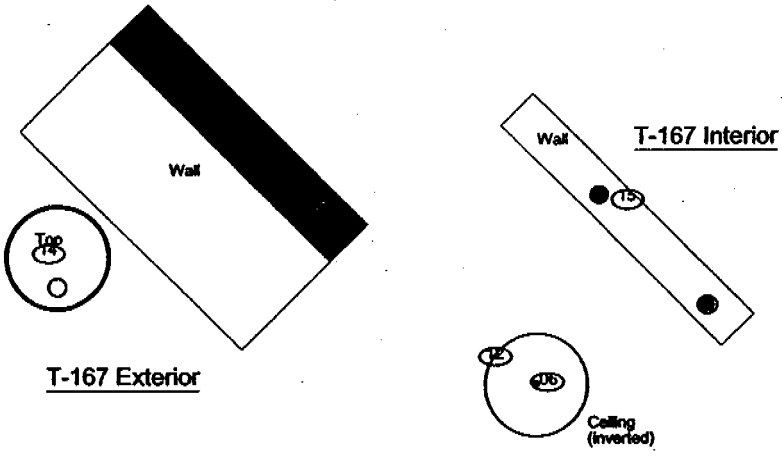
Total Floor Area: NA **Total Area: 547 sq. m** **Grid Size: N/A**

SURVEY UNIT - MAP 1 OF 1



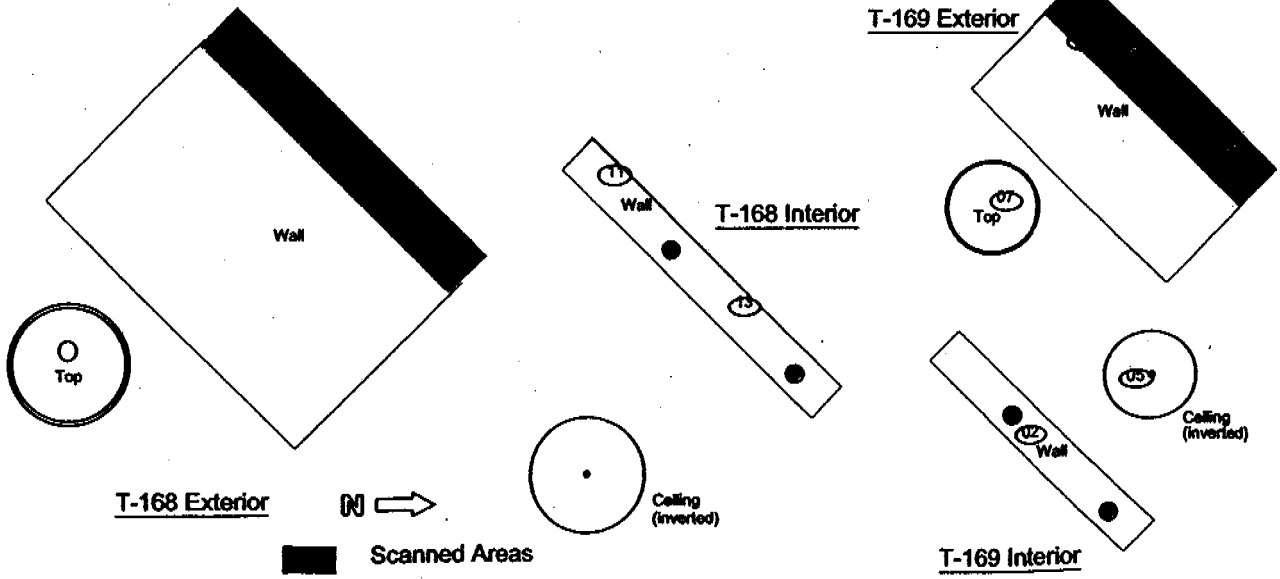
T-165 Exterior

T-165 Interior



T-167 Exterior

T-167 Interior



T-168 Exterior

T-168 Interior

T-169 Exterior

T-169 Interior

N

Scanned Areas

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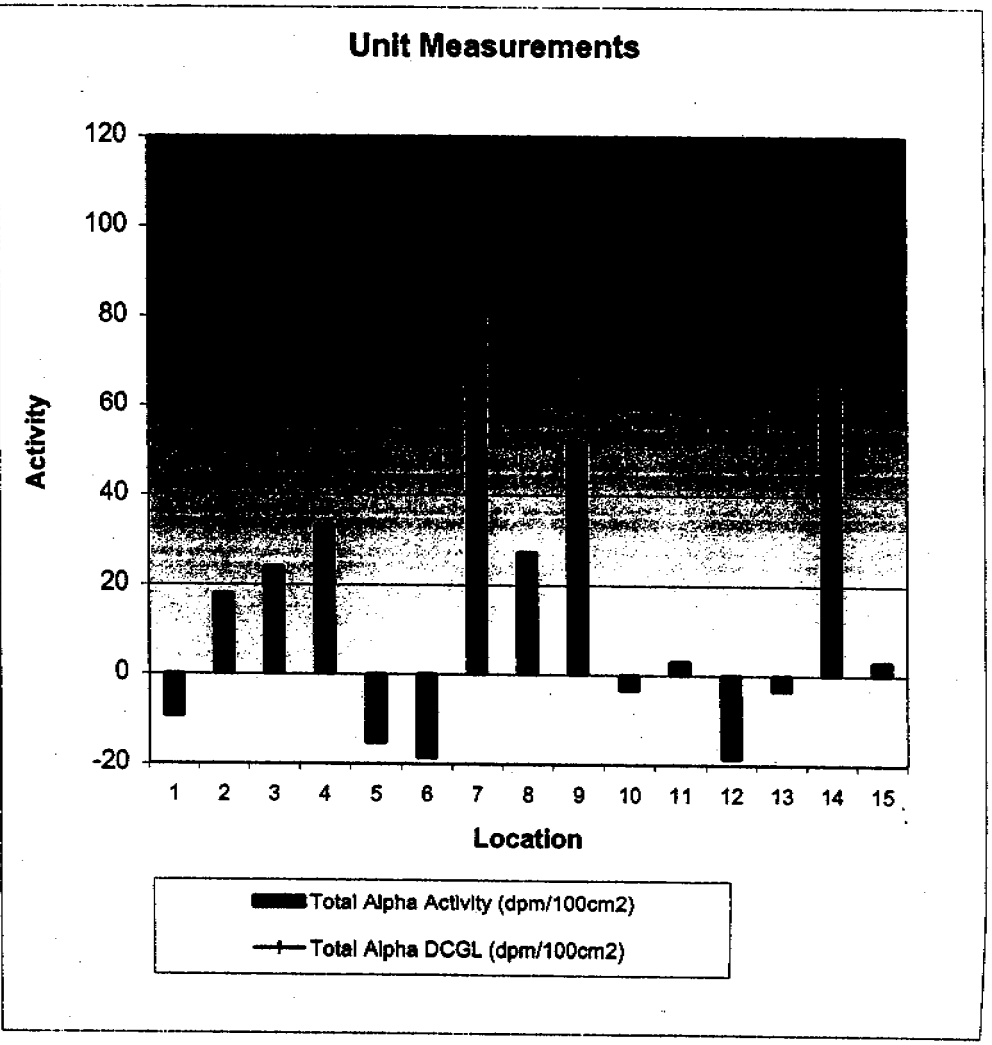
TSA Alpha

371004

8/26/01

				Instrument	2146	1380	1526
standard deviation:	31.6	max:	85.6	Ave. Instrument background:	6.0 cpm	6.0 cpm	2.4 cpm
mean:	16.1	min:	-18.6	Instrument efficiency:	22.1%	21.8%	21.1%
median:	3.0			Instrument MDA:	48 dpm	48 dpm	48 dpm

	Surface Location	Total Alpha Counts (cpm/100cm²)	Local Area Bkgd (cpm/100cm²)	Total Alpha Activity (dpm/100cm²)	Total Alpha DCGL (dpm/100cm²)
1	Tanks 165, 167, 168, 169	4.0	9.3	-9.4	100
2	Tanks 165, 167, 168, 169	10.0	4.0	18.1	100
3	Tanks 165, 167, 168, 169	11.3	6.7	24.1	100
4	Tanks 165, 167, 168, 169	13.3	10.0	33.3	100
5	Tanks 165, 167, 168, 169	2.7	4.7	-15.4	100
6	Tanks 165, 167, 168, 169	2.0	4.7	-18.6	100
7	Tanks 165, 167, 168, 169	24.7	4.0	85.6	100
8	Tanks 165, 167, 168, 169	12.0	2.0	27.3	100
9	Tanks 165, 167, 168, 169	17.3	8.7	51.6	100
10	Tanks 165, 167, 168, 169	5.3	3.3	-3.4	100
11	Tanks 165, 167, 168, 169	6.7	7.3	3.0	100
12	Tanks 165, 167, 168, 169	2.0	4.0	-18.6	100
13	Tanks 165, 167, 168, 169	5.3	6.7	-3.4	100
14	Tanks 165, 167, 168, 169	20.0	5.3	64.0	100
15	Tanks 165, 167, 168, 169	6.7	10.0	3.0	100
7 QC	Tanks 165, 167, 168, 169	24.7	2.0	105.9	100
9 QC	Tanks 165, 167, 168, 169	13.3	2.7	51.9	100



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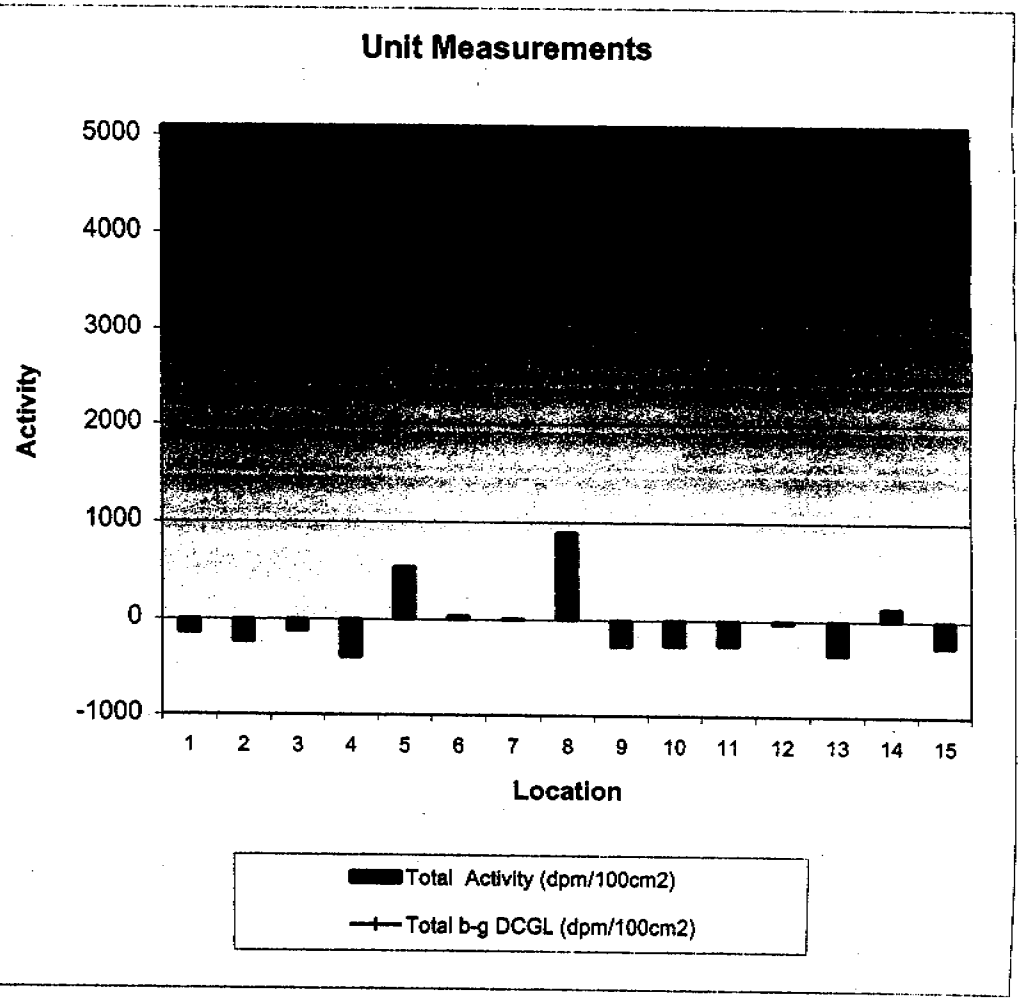
Total TSA Beta-Gamma

371004

8/26/01

				Instrument	2146	1380	1526
standard deviation:	351.3	max:	896.7	Ave. Instrument background:	434.6 cpm	434.6 cpm	336.5 cpm
mean:	-50.5	min:	-392.8	Instrument efficiency:	33.9%	33.5%	29.8%
median:	-148.1			Instrument MDA:	318 dpm	318 dpm	318 dpm

	Surface Location	Total Counts (cpm/100cm²)	Local AreaBkgd (cpm/100cm²)	Total Activity (dpm/100cm²)	Total β–γ DCGL (dpm/100cm²)
1	Tanks 165, 167, 168, 169	385.0	549.0	-148.1	5000
2	Tanks 165, 167, 168, 169	356.0	449.0	-234.6	5000
3	Tanks 165, 167, 168, 169	392.0	399.0	-127.2	5000
4	Tanks 165, 167, 168, 169	303.0	332.0	-392.8	5000
5	Tanks 165, 167, 168, 169	614.0	604.0	535.5	5000
6	Tanks 165, 167, 168, 169	446.0	446.0	34.0	5000
7	Tanks 165, 167, 168, 169	437.0	427.0	7.2	5000
8	Tanks 165, 167, 168, 169	735.0	610.0	896.7	5000
9	Tanks 165, 167, 168, 169	343.0	343.0	-273.4	DrvQueryFor
10	Tanks 165, 167, 168, 169	345.0	377.0	-267.5	5000
11	Tanks 165, 167, 168, 169	347.0	388.0	-261.5	5000
12	Tanks 165, 167, 168, 169	423.0	437.0	-34.6	5000
13	Tanks 165, 167, 168, 169	317.0	362.0	-351.0	5000
14	Tanks 165, 167, 168, 169	477.0	417.0	126.6	5000
15	Tanks 165, 167, 168, 169	345.0	379.0	-267.5	5000
7 QC	Tanks 165, 167, 168, 169	426.0	377.0	300.3	5000
9 QC	Tanks 165, 167, 168, 169	346.0	296.0	31.9	5000



PC

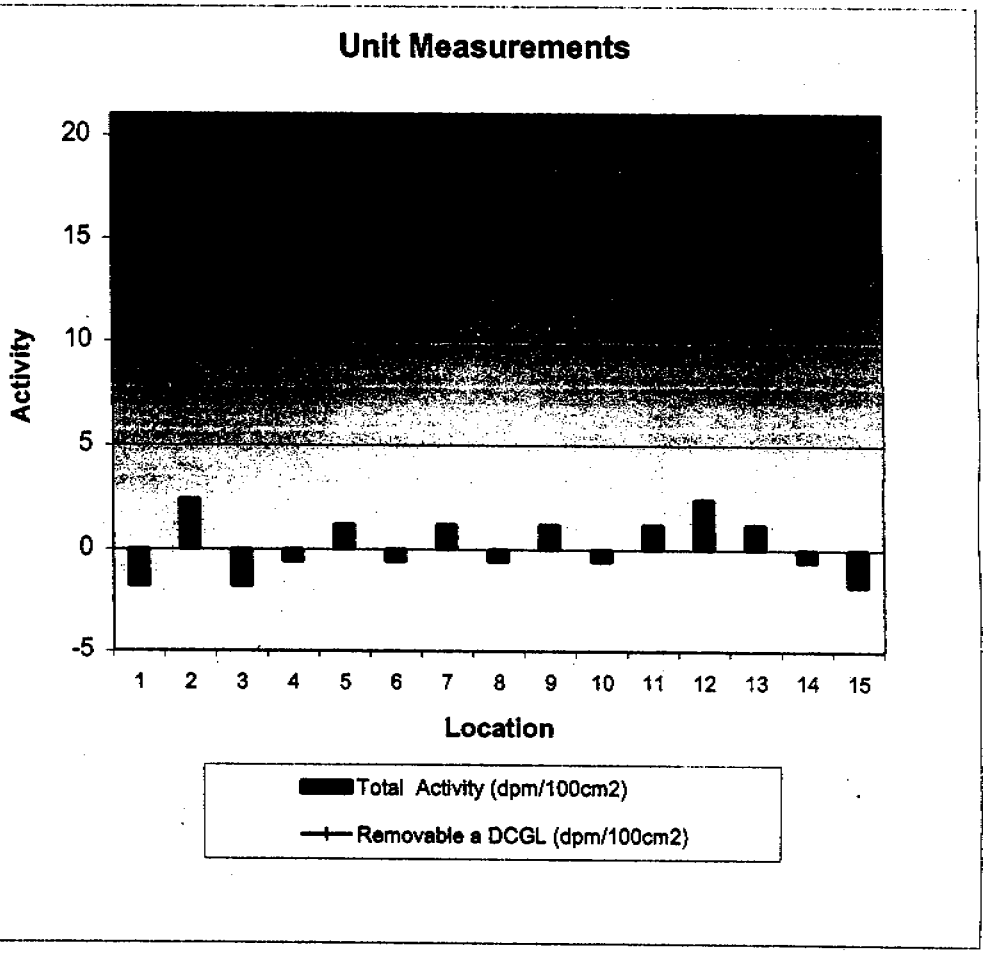
Removable Activity - Alpha

371004

8/26/01

				Instrument:	1428	1430
standard deviation:	1.5	max:	2.4	Instrument background:	0.6 cpm	0.2 cpm
mean:	0.2	min:	-1.8	Instrument efficiency:	33.0%	33.0%
median:	-0.6			Instrument MDA:	10 dpm	10 dpm

	Surface Location	Total Counts (cpm/100cm²)	Bkgd (cpm/100cm²)	Total Activity (dpm/100cm²)	Removable α DCGL (dpm/100cm²)
1	Tanks 165, 167, 168, 169	0.0	0.6	-1.8	20
2	Tanks 165, 167, 168, 169	1.0	0.2	2.4	20
3	Tanks 165, 167, 168, 169	0.0	0.6	-1.8	20
4	Tanks 165, 167, 168, 169	0.0	0.2	-0.6	20
5	Tanks 165, 167, 168, 169	1.0	0.6	1.2	20
6	Tanks 165, 167, 168, 169	0.0	0.2	-0.6	20
7	Tanks 165, 167, 168, 169	1.0	0.6	1.2	20
8	Tanks 165, 167, 168, 169	0.0	0.2	-0.6	20
9	Tanks 165, 167, 168, 169	1.0	0.6	1.2	20
10	Tanks 165, 167, 168, 169	0.0	0.2	-0.6	20
11	Tanks 165, 167, 168, 169	1.0	0.6	1.2	20
12	Tanks 165, 167, 168, 169	1.0	0.2	2.4	20
13	Tanks 165, 167, 168, 169	1.0	0.6	1.2	20
14	Tanks 165, 167, 168, 169	0.0	0.2	-0.6	20
15	Tanks 165, 167, 168, 169	0.0	0.6	-1.8	20



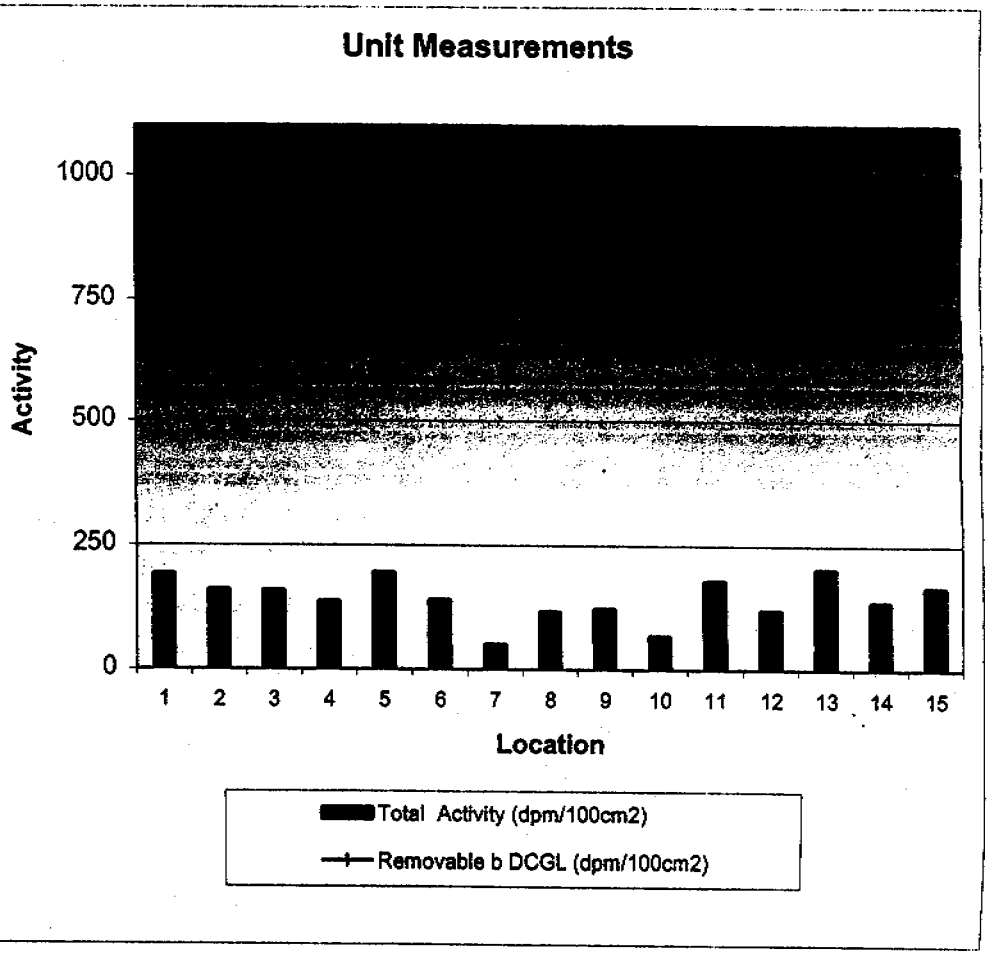
Removable Activity - Beta-Gamma

371004

8/26/01

				Instrument:	960	872
standard deviation:	43.7	max:	202.8	Instrument background:	26.3 cpm	33.9 cpm
mean:	143.0	min:	50.8	Instrument efficiency:	25.0%	25.0%
median:	140.4			Instrument MDA:	200 dpm	200 dpm

	Surface Location	Total Counts (cpm/100cm²)	Bkgd (cpm/100cm²)	Total Activity (dpm/100cm²)	Removable β DCGL (dpm/100cm²)
1	Tanks 165, 167, 168, 169	74.0	26.3	190.8	1000
2	Tanks 165, 167, 168, 169	74.0	33.9	160.4	1000
3	Tanks 165, 167, 168, 169	66.0	26.3	158.8	1000
4	Tanks 165, 167, 168, 169	68.0	33.9	136.4	1000
5	Tanks 165, 167, 168, 169	75.0	26.3	194.8	1000
6	Tanks 165, 167, 168, 169	69.0	33.9	140.4	1000
7	Tanks 165, 167, 168, 169	39.0	26.3	50.8	1000
8	Tanks 165, 167, 168, 169	63.0	33.9	116.4	1000
9	Tanks 165, 167, 168, 169	57.0	26.3	122.8	1000
10	Tanks 165, 167, 168, 169	51.0	33.9	68.4	1000
11	Tanks 165, 167, 168, 169	71.0	26.3	178.8	1000
12	Tanks 165, 167, 168, 169	64.0	33.9	120.4	1000
13	Tanks 165, 167, 168, 169	77.0	26.3	202.8	1000
14	Tanks 165, 167, 168, 169	68.0	33.9	136.4	1000
15	Tanks 165, 167, 168, 169	68.0	26.3	166.8	1000
16					
17					



SURVEY UNIT
371005

SURVEY PACKAGE COVER SHEET

Survey Area: CC	**Survey Unit:** 371005	**Building/Structure:** T167/8/9 Berm

Survey Unit/Area Description:
Tanks 167, 168, & 169 secondary containments and tank pads for tanks 165, 167, 168, & 169.

Building Information:

Survey Type: Reconnaissance Level Characterization Survey ☐ Pre-Demolition Survey ☑

Building Type: Type 1 ☑ Type 2 ☐ Type 3 ☐

Classification: Class 1 ☐ Class 2 ☐ Class 3 ☑ Unknown ☐

Contaminants of Concern: Plutonium ☑ Uranium ☑ Other ☐

Justification for Classification: *No history of radiological operations or material storage. Areas not expected to contain any residual radioactivity greater than* $DCGL_w$. No individual measurements are expected to exceed the indicated value.

Special Support Requirements: None.

Special Safety Requirements: Survey personnel shall be trained for ladder safety.

Isolation Controls:
LEVEL 1 ☐ LEVEL 2 ☑ N/A ☐
No use, storage, or movement of radioactive material, with the exception of instrument check sources, is permitted in this survey unit.

Labeling Requirements: Survey locations are identified as indicated on the attached survey unit map(s). Survey location numbers will be annotated at each survey location.

Survey Package Implementation:

D. A. Barnes			8/23/01
Radiological Engineer Printed Name	Employee #	Radiological Engineer Signature	Date
Larry Rands			8/23/01
Radiological Engineer Printed Name	Employee #	Radiological Engineer Signature	Date

Comments:

Survey Package Closure:

Radiological Engineer Printed Name	Employee #	Radiological Engineer Signature	Date
Radiological Engineer (Peer Review) Printed Name	Employee #	Radiological Engineer (Peer Review) Signature	Date
RE Manager or RSM Printed Name	Employee #	RE Manager or RSM Signature	Date

(PRO-475-RSP-16.01, effective 05/22/01)

SURVEY PACKAGE TRACKING FORM

Survey Area:	Survey Unit:	Initiator/ Date	Release Date	Validation Date	Closure Date
CC	371005				

(PRO-475-RSP-16.01, effective 05/22/01)

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SURVEY PACKAGE CORRECTION/CHANGE HISTORY FORM

Survey Area:	CC	Survey Unit:	371005	Building/Structure:	T167/8/9 Berm

Change #	Description	Initiator/ Date	RE
1	Changed "Pre" & "Post" to "Alpha" & "Beta" on page 10.	Barnes/8-24-01	
2	Changed Calculation Worksheet Package ID to "371 N Side Project - T167/168/169 Berm".	Barnes/9-4-01	

(PRO-475-RSP-16.01, effective 05/22/01)

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SURVEY PACKAGE SURVEY/SAMPLING INSTRUCTION FORM

Survey Area:	CC	Survey Unit:	371005	Building/Structure:	T167/8/9 Berm

Survey Unit/Area Description:

Tanks 167, 168, & 169 secondary containments and tank pads for tanks 165, 167, 168, & 169.

Minimum Survey/Sampling Measurement Requirements

Measurement	Number and Type	Comments
Surface Activity Measurements	**TOTAL SURFACE CONTAMINATION** 15 – Alpha & Beta-Gamma **REMOVABLE SURFACE CONTAMINATION** 15 – Alpha & Beta-Gamma	90-second count time required 2-minute count time required Note: All locations are denoted on survey package survey map.
RE Verification	D. A. Barnes (Print Name) / Employee # / Signature / 8/23/01 (Date)	
Surface Scanning	Alpha & Beta-Gamma scans at 3% of accessible surfaces at biased locations (i.e., doorways, lower walls, floors, etc.)	Refer to attached flowchart for scanning instructions with DP6 probe.
RE Verification	D. A. Barnes (Print Name) / Employee # / Signature / 8/23/01 (Date)	
Media Samples	N/A	N/A
RE Verification	Print Name / Employee #	Signature / Date

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Survey Area:	CC	Survey Unit:	371005	Building/Structure:	T167/8/9 Berm

Survey Unit/Area Description:

Tanks 167, 168, & 169 secondary containments and tank pads for tanks 165, 167, 168, & 169.

Survey/Sampling Instructions

- **NOTE:** Any changes to the Survey Package must be logged in the "Survey Package Corrections/Change History Form."
- **RCT** – If not already completed, label the survey unit surfaces per the Survey Package Cover Sheet Grid Requirements Section and the attached survey map(s).
- **RCT** – If not already completed, transpose sample numbers from attached survey maps onto each corresponding survey location on the survey unit surfaces.
- **RCT** – Perform pre-use performance checks of all instrumentation to be utilized in conjunction with this survey package. *A priori* Minimum Detectable Concentrations (MDCs) listed in the RFETS Pre-Demolition Survey Plan (PDSP) may be used. If MDCs are calculated, use the formula indicated below in the sampling instructions. Verify that computed MDCs are less than 50% of the applicable $DCGL_W$. Record all information on the Instrument Data Sheet.
- **RCT** – When calculating MDC values for smears and static field measurements, use the following equation:

$$MDC = \frac{3 + 3.29\sqrt{R_b t_s (1 + \frac{t_s}{t_b})}}{E_t (A/100) t_s}$$

Where,

R_b = Background counting rate
t_s = sample counting time interval
t_b = background counting time
E_t = total efficiency
A = physical surface area of the detector (or area sampled for smears)

Note: Ensure that a 90 second count time is utilized when determining the MDC of the NE Electra. A ten minute background and a two minute sample count time shall be used for the SAC-4. This will allow a correspondence between the MDC calculations and field measurements.

Note: Perform TSA (first) background (second), and removable measurements (third), at a location to the right of the sample location labels. If this area is not accessible, then move in a clockwise direction of the sample location label until a suitable location is revealed. DO NOT perform TSA and removable surveys on the sample location sticker itself.

- **RCT** – Obtain a local area background measurement using a shielded probe (¾ inch slab of wood that will be provided) or by turning the probe to face away from the surface being measured. Local Area Background values should be obtained at each TSA measurement location just AFTER obtaining the actual total surface activity. Place the probe shield at the same location the field measurement is to be taken and record the actual background reading (cpm) on the appropriate form.

Survey Area:	CC	Survey Unit:	371005	Building/Structure:	T167/8/9 Berm

Survey Unit/Area Description:

Tanks 167, 168, & 169 secondary containments and tank pads for tanks 165, 167, 168, & 169.

Survey/Sampling Instructions

- **RCT** - Obtain 100cm^2 total surface activity measurements (and local area background measurements) at each labeled measurement location per 3-PRO-476-RSP 16.02, Radiological Surveys of Surfaces and Structures. Record the results on the "Total Surface Activity Data Sheet".

- **RCT** - Obtain 100cm^2 removable smears at each labeled measurement per 3-PRO-476-RSP 16.02, Radiological Surveys of Surfaces and Structures. Record the results on the "Removable Contamination Data Sheet". Ensure that a background count time of 10 minutes and a sample count time of 2 minutes is used.

- **RCT** – perform Scans and investigation scans (if applicable) as described on attached flowchart. Complete the "Scan and Investigation Data Sheet" as appropriate.

  Note (NE Electra): Given the total alpha contamination action level of 225 dpm/100 cm^2 (75% of $DCGL_{EMC}$), and a probability of detection of 67%, the appropriate scan rate for alpha measurements is 1.5 in/s (~3.81 cm/s). Upon initial detection of a single count, the surveyor should pause over the area for 4 seconds. If one or more counts is observed in that time interval (equivalent to 15 cpm on NE Electra display), the surveyor should perform a 30-second TSA on the area (Refer to Investigation Flowchart for additional guidance).

  Note (Radhound Final Survey Monitor): If the $DCGL_{EMC}$ investigation limit (225 dpm/100 cm^2) is exceeded / detected, then RCT shall perform investigation with the NE Electra in accordance with attached flowchart. Radhound Final Survey Monitor scan rates are determined utilizing incorporated software in the field (see Radhound Manual for technical basis). Areas to be scanned shall be marked to include grid location corners, at a minimum, to confirm measurement locations are traceable.

- **RCT** – When values are less than the Minimum Detectable Concentration (MDC), the actual value shall be annotated on the survey form.

- **RCT** – In the event any removable measurement exceeds 20 dpm/100cm^2 alpha, any total activity measurement exceeds 100 dpm/100cm^2 alpha, or any scan measurement exceeds 225 dpm/100cm^2 alpha, notify the cognizant Radiological Engineer. Radiological Engineering will evaluate to determine if the elevated reading represents actual DOE-added material, NORM, or statistical anomalies prior to any decision-making process or additional investigation methods.

- **RCT** - Collect QC measurements (90 sec., TSA only) at a frequency of 5% of the total number of initial measurement locations (minimum of 2 per survey unit). Do not collect measurements at locations of zero or negative initial results. QC measurements are to be collected with a different instrument and by a different technician than the original survey.

- **RCT** – Complete the attached "Instrument Data Sheet" for all instrumentation used for this final survey.

- **RCT** – Complete the attached "Survey Signature Sheet" and forward the survey package to the RCT Foreman for review.

- **RCT** - Perform post-use performance checks immediately following use, typically following the conclusion of measurements on the same day. The post-use performance checks SHALL fall within ± 20% of the established range to be considered acceptable.

- **RCT Supervisor** – Review the applicable forms in the survey package for completeness, complete the attached "Survey Package Validation Checklist Form" and the "Survey Signature Sheet," and forward the survey package to Characterization Radiological Engineering for final disposition.

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SURVEY PACKAGE CALCULATION WORKSHEET

371 N. SIDE PROJECT - T167/168/169 BERM.

Package ID: ~~Bldg 865 cluster exteriors~~ 9-4-01	Building: T167/8/9 Berm
Survey Area: CC	Survey Unit: 371005

Survey Unit/Area Description:

Tanks 167, 168, & 169 secondary containments and tank pads for tanks 165, 167, 168, & 169.

☑ **Total Surface Activity**	☐ **Media Surface Activity**
☑ **Removable Surface Activity**	☐ **Volumetric Activity**

Step 1: Calculate the relative shift Δ/σ_s.

$\Delta/\sigma_s = (DCGL-LBGR)/\sigma_s$

$\Delta/\sigma_s =$

where:

- Δ/σ_s is the relative shift or the resolution of measurements in units of measurement uncertainty (MARSSIM recommends a value between 1 and 3).
- DCGL is the total surface activity derived concentration guideline value (DOE Order 5400.5 total surface activity limit equals 100 dpm/100cm^2 for transuranics)
- LBGR is the lower bound of the gray region - the lower bound of the range of values of the parameter of interest in a survey unit where the consequences of making a decision error is relatively minor. The LBGR TSA was adjusted to obtain a relative shift between 1 and 3 (i.e.. 40 dpm/100cm^2 for transuranics).
- σ_s is the estimated standard deviation of the total surface activity measurements (MARSSIM recommends assuming a 30% coefficient of variation if scoping or characterization data is not available)

Step 2: Determine Sign p using the calculated relative shift and Table 4. Sign p is the estimated probability that a random measurement from the survey unit will be less than the $DCGL_w$ when the survey unit median is actually at the LBGR.

Step 3: Determine Decision Error Percentiles for Z1-α and Z1-β and the selected decision error levels α and . Typical (α) and (β) values used at RFETS are 0.05 and 0.05 respectively. This yields a Z1-α and Z1-β value of 1.645 and 1.645 respectively.

Step 4: Calculate Number of Data Points (N) for Sign Test using the following equation:

$$N = \frac{(Z_{1-\alpha} + Z_{1-\beta})^2}{4(Sign\,p - 0.5)^2}$$

$N = (1.645 + 1.645)^2 / 4(\text{Sign p} - 0.5)^2$

$N = (1.645 + 1.645)^2 / 4(0.977250-0.5)^2 = 11.88$

where:

- 1.645 is the alpha and beta decision error value (95% confidence) per the PDSP.
- Sign p equals 0.977250

Step 4: Increase N by 20% to allow for missing or invalid data points per MARSSIM, Section 5.5.2.3.

$N = 11.88 * 1.2 = 14.25$

Step 5: Increase the number of data points by 20% to ensure sufficient power of the tests and to allow for possible data losses.

Conclusion: A minimum of 15 Total Surface and Removable Activity measurements will required for each survey unit.

D. A. Barnes			8/23/01
RE Printed Name	Employee #	Radiological Engineer Signature	Date
Larry Rands			8/23/01
RE (Peer Review) Print Name	Employee #	Radiological Engineer Signature	Date

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Survey Area: CC	Survey Unit: 371005	Building: T167/8/9 Berm

Survey Unit/Area Description:
Tanks 167, 168, & 169 secondary containments and tank pads for tanks 165, 167, 168, & 169.

SURVEY SIGNATURE SHEET

REMOVABLE/TOTAL SURFACE ACTIVITY/SCAN SURVEYS PERFORMED BY

	RCT Printed Name	Employee #	RCT Signature	Date
RCT ID # 1	Marcus Chase		Marcus Chase	8-28-01
RCT ID # 2	Kieven Parks		Kieven Parks	8-28-01
RCT ID # 3	Daniel Conley		Daniel Conley	8-28-01
RCT ID # 4	WM Krueger		WM Krueger	8-28-01
RCT ID # 5	Anita Vaur			8-28-01
RCT ID # 6	F. F. Riddle		F. F. Riddle	8-28-01

Quality Control Measurements Performed By

	RCT Printed Name	Employee #	RCT Signature	Date
RCT ID # 7	Daniel Conley		Daniel Conley	8-28-01
RCT ID # 8				
RCT ID # 9				
RCT ID # 10				

Survey Reviewed By

RCT Supervision Printed Name	Employee #	RCT Supervision Signature	Date
L. T. Ruffin		R J Ruffin	8-28-01

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Survey Area:	CC	Survey Unit:	371005	Building:	T167/8/9 Berm

Survey Unit/Area Description:

Tanks 167, 168, & 169 secondary containments and tank pads for tanks 165, 167, 168, & 169.

INSTRUMENT DATA SHEET

Removable Activity Survey Instrument Data

Manufacturer	Eberlinee	Eberline	Eberline	Eberline		
Model	SAC-4	SAC-4	BC-4	BC-4		
	1	2	3	4	5	6
Serial #	1428	1430	960	872		
Cal. Due Date	2/11/02	11/3/01	8/31/01	7/26/02		
ANALYSIS DATE	8/26/01	8/26/01	8/26/01	8/26/01		
Alpha Bkgd. (cpm)	0.4	0.1				
Alpha Eff. (c/d)	33.0%	33.0%				
Intrument α MDC ($dpm/100cm^2$)	10.0	10.0				
Beta Bkgd. (cpm)			30.7	33.2		
Beta Eff. (c/d)			25.0%	25.0%		
Intrument β MDC ($dpm/100cm^2$)			200	200		

Total Surface Activity Instrument Data

Manufacturer	NE	NE				
Model	Electra	Electra				
	1	2	3	4	5	6
Serial #	1526	1380				
Cal. Due Date	1/11/02	10/3/01				
ANALYSIS DATE	8/25/01	8/25/01				
Alpha Bkgd. (cpm)	3.0	2.0				
Alpha Eff. (c/d)	21.1%	21.8%				
Intrument α MDC ($dpm/100cm^2$)	48	48				
Beta Bkgd. (cpm)	415	458				
Beta Eff. (c/d)	29.8%	33.5%				
Intrument β MDC ($dpm/100cm^2$)	318	318				

Survey Area:	CC	Survey Unit:	371005	Building:	T167/8/9 Berm

Survey Unit/Area Description:

Tanks 167, 168, & 169 secondary containments and tank pads for tanks 165, 167, 168, & 169.

Total Surface Activity Data Sheet

Sample Location	Material Type (If Required)	Alpha Total Surface Activity Measurements				Beta-Gamma Total Surface Activity Measurements			
		RCT ID #	Inst. ID #	Gross (cpm)	LAB (cpm)	RCT ID #	Inst. ID #	Gross (cpm)	LAB (cpm)
1	Concrete	5	2	16.0	4.0	5	2	810	553
2		5	2	31.3	4.0	5	2	397	405
3		5	2	12.7	2.0	5	2	647	460
4		5	2	5.3	3.3	5	2	687	476
5		5	2	12.7	2.0	5	2	704	486
6		5	2	16.0	8.0	5	2	847	576
7		5	2	14.0	4.7	5	2	655	447
8		5	2	10.0	3.3	5	2	752	631
9		6	2	8.7	2.7	6	2	672	457
10		6	2	14.7	2.0	6	2	684	485
11		6	2	27.3	3.3	6	2	655	459
12		6	2	14.7	3.3	6	2	664	506
13		6	2	16.7	3.3	6	2	736	449
14	▼	6	2	11.3	3.3	6	2	693	503
15	Concrete	6	2	16.0	6.7	6	2	765	594
16									
17									
18									
19									
20									
2 QC	Concrete	7	1	37.3	4.2	7	1	482	500
11 QC	Concrete	7	1	29.3	4.3	7	1	845	595

Comments:

COUNT TIME = 90 (SEC)

Note: QC measurements are to be collected with a different instrument than the original survey. Mark the QC location number in the "Sample Location" column.

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Survey Area:	CC	Survey Unit:	371005	Building:	T167/8/9 Berm

Survey Unit/Area Description:

Tanks 167, 168, & 169 secondary containments and tank pads for tanks 165, 167, 168, & 169.

Removable Activity Data Sheet

Location #	RCT ID #	Inst. ID #		Gross counts	
		α	β	α	β
1	1	2	3	0.0	69
2	2	1	4	2.0	76
3	1	2	3	1.0	73
4	2	1	4	0.0	70
5	1	2	3	0.0	57
6	2	1	4	1.0	81
7	1	2	3	0.0	61
8	2	1	4	1.0	77
9	1	2	3	2.0	52
10	2	1	4	2.0	78
11	1	2	3	0.0	53
12	2	1	4	0.0	73
13	1	2	3	0.0	60
14	2	1	4	0.0	68
15	1	2	3	1.0	68
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					

Comments:

All readings from SAC-4 & BC-4 are 2 minute counts

COUNT TIME = 120 (SEC)

(PRO-475-RSP-16.01, effective 05/22/01)

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Survey Area: CC	Survey Unit: 371005	Building: T167/8/9 Berm

Survey Unit/Area Description:

Tanks 167, 168, & 169 secondary containments and tank pads for tanks 165, 167, 168, & 169.

Scan Survey/Investigation Documentation Formt

Location #	NE Electra Alpha					NE Electra Beta			
	RCT ID #	Inst. ID #	4-sec Audible observed? "Y" or "N"	30-sec Static (gcpm)	90-sec Direct (dpm/100cm^2)	RCT ID #	Inst. ID #	Elevated Audible observed? "Y" or "N"	60-sec Direct (dpm/100cm^2)
D1	3	1	Yes	14					
D2	3	1	Yes	12					
D3	3	1	Yes	24					
D4	3	1	Yes	26					
D5	3	1	Yes	20					
D6	2	1	Yes	18					
D7	2	1	Yes	24					
D8	2	1	Yes	16					
D9	3	1	Yes	4					
D10	2	1	Yes	8					
D11	2	1	Yes	20					
D12	3	1	Yes	18					
D13	3	1	Yes	10					
D14	3	1	Yes	26					
02	2	1	NA	NA	128				
11	2	1	NA	NA	88				

NOTE: Refer to the Instrument Data Sheet and Survey Signature Sheet for instrumentation, surveyor & approval information.

Results/Comments:

3% of surface area.

Scan 16.01 m^2.

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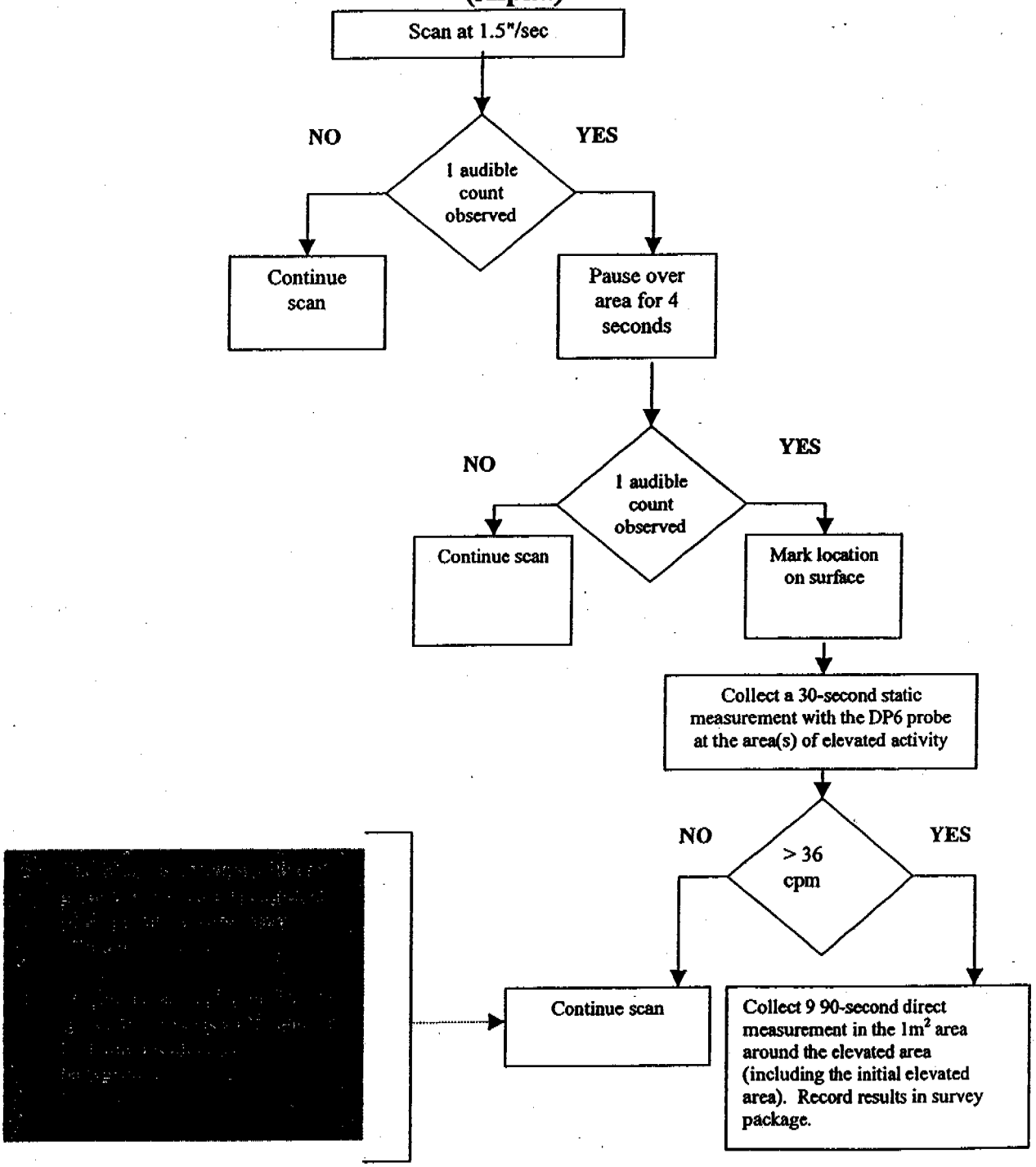
Scan Method with DP6 (example) (Alpha)



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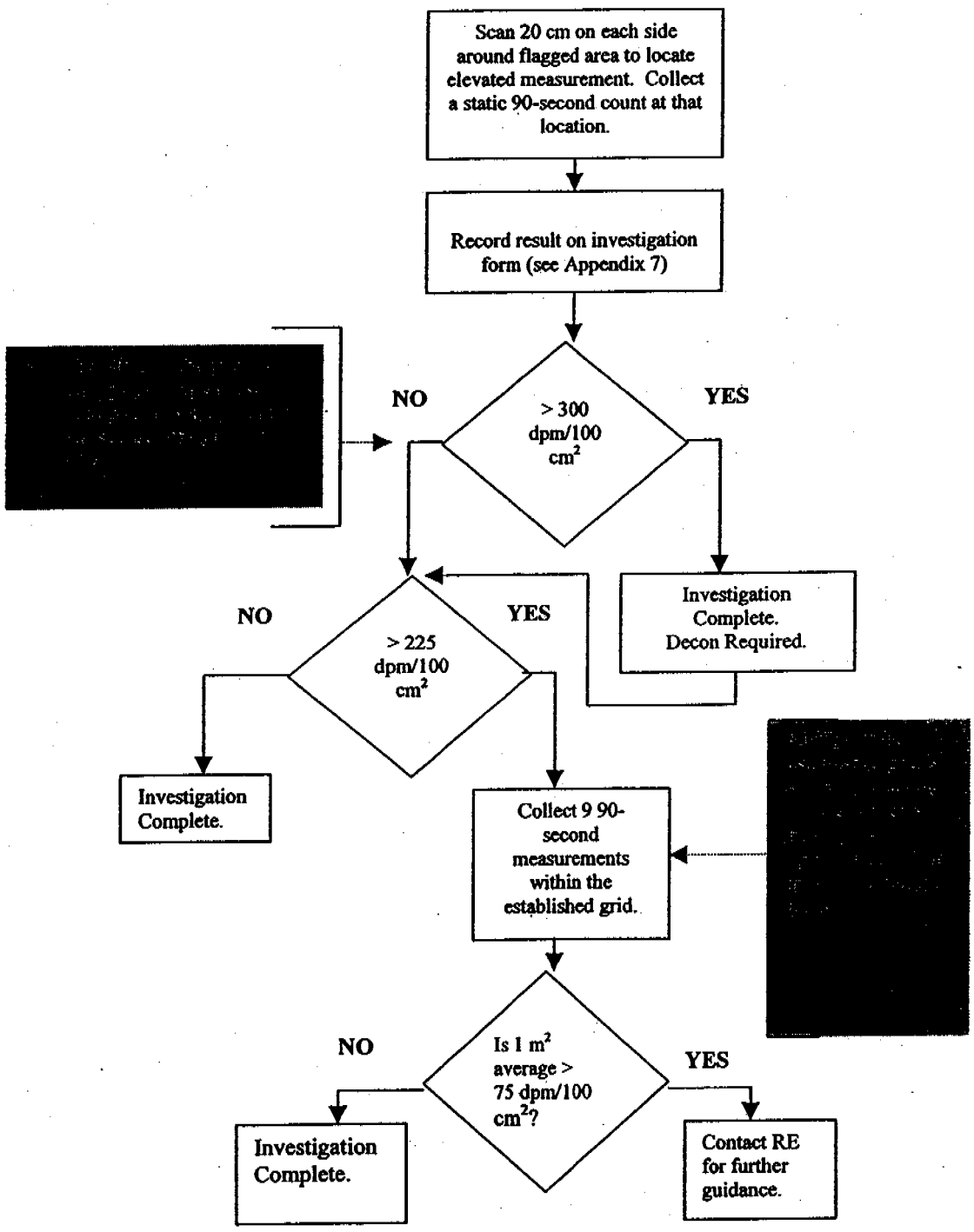
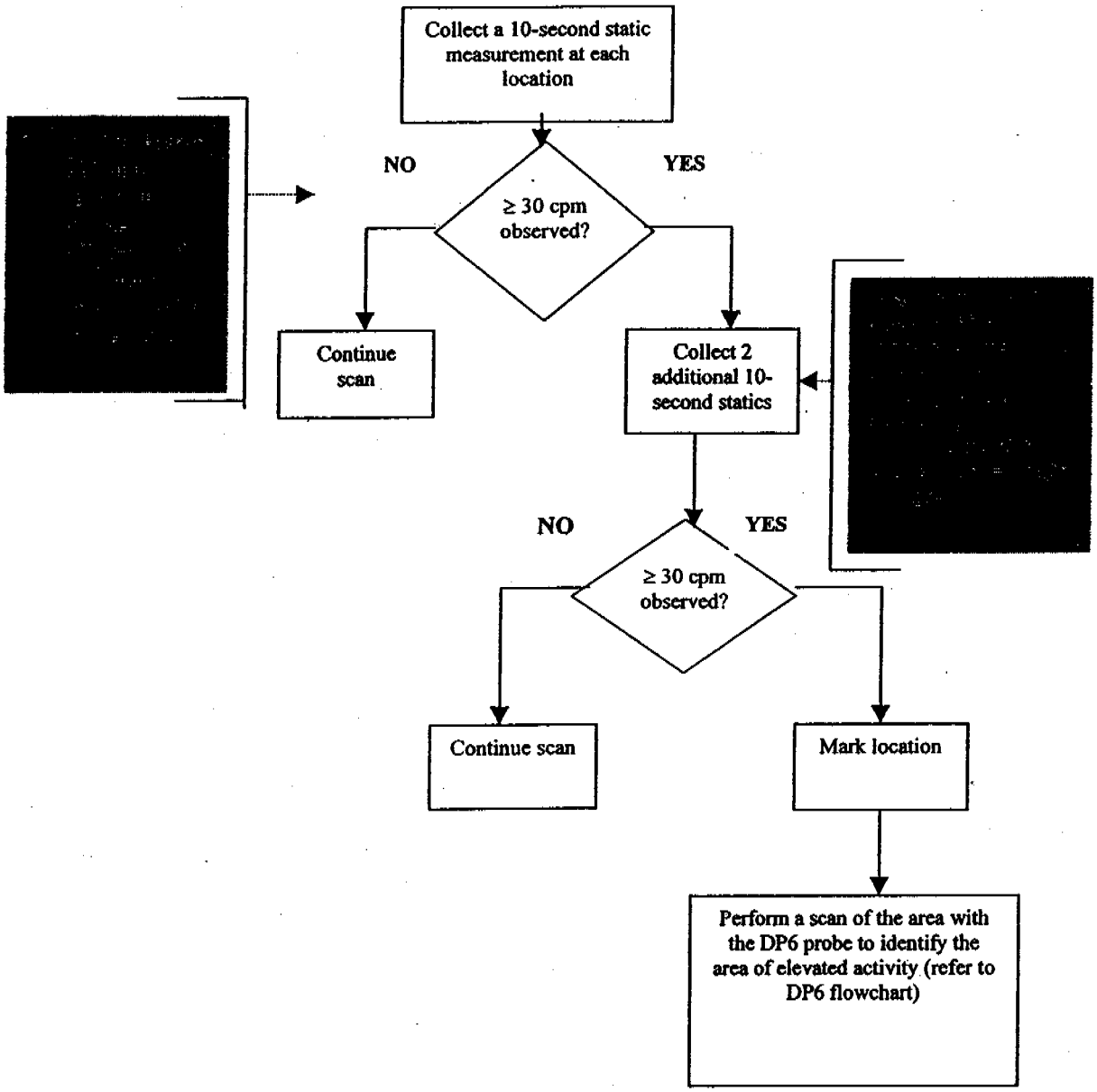
Investigation Method with DP6 (example) (Alpha)



Alpha Scan Method with DP8A or equivalent (example)
Revision 1



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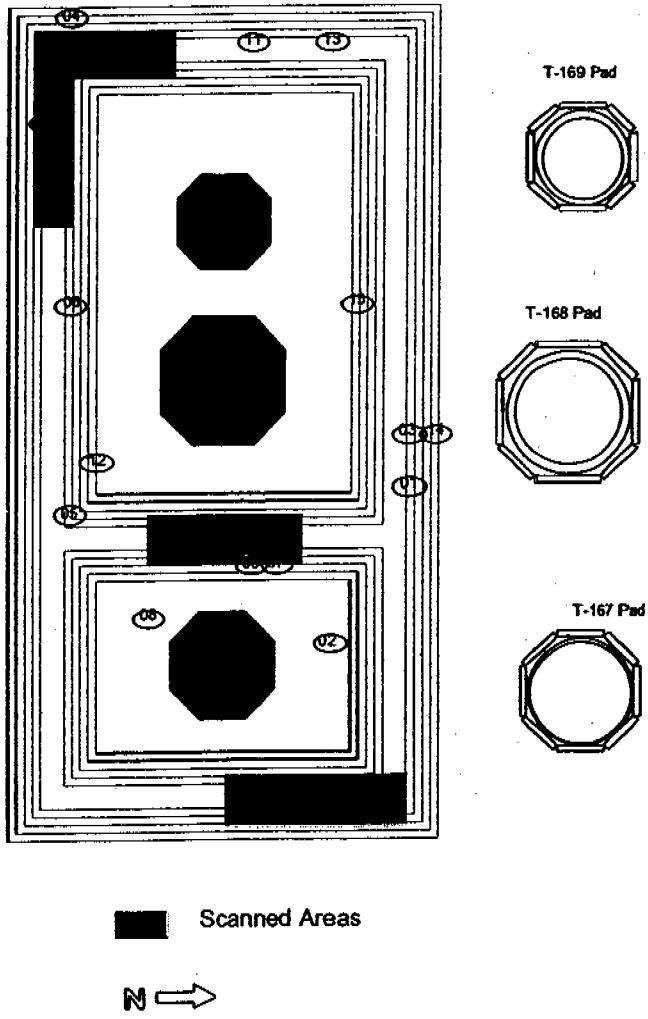
RADIOLOGICAL CLOSEOUT SURVEY FOR

Survey Area: NA **Survey Unit: 371005** **Classification: 3**
Building: 374
Survey Unit Description: Berms for T-167, T168, T-169

Total Floor Area: NA **Total Area: 536 sq. m** **Grid Size: N/A**

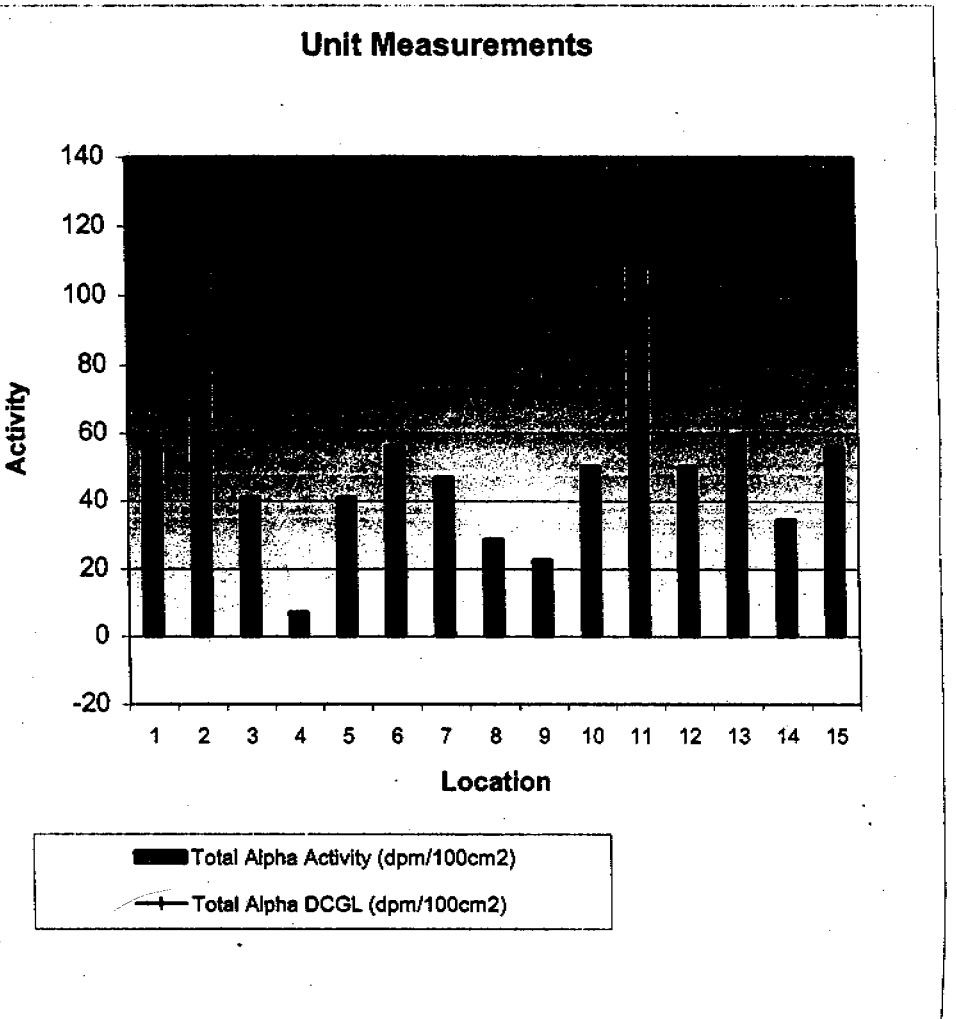
SURVEY UNIT - MAP 1 OF 1



TSA Alpha **371005** 8/25/01

				Instrument	1526	1380
standard deviation:	30.2	max:	126.5	Ave. Instrument background:	4.3 cpm	3.7 cpm
mean:	52.4	min:	7.2	Instrument efficiency:	21.1%	21.8%
median:	50.3			Instrument MDA:	48 dpm	48 dpm

	Surface Location	Total Alpha Counts (cpm/100cm²)	Local Area Bkgd (cpm/100cm²)	Total Alpha Activity (dpm/100cm²)	Total Alpha DCGL (dpm/100cm²)
1	165/7/8/9 Sec. Contm'ts	16.0	4.0	56.3	100
2	165/7/8/9 Sec. Contm'ts	31.3	4.0	126.5	100
3	165/7/8/9 Sec. Contm'ts	12.7	2.0	41.2	100
4	165/7/8/9 Sec. Contm'ts	5.3	3.3	7.2	100
5	165/7/8/9 Sec. Contm'ts	12.7	2.0	41.2	100
6	165/7/8/9 Sec. Contm'ts	16.0	8.0	56.3	100
7	165/7/8/9 Sec. Contm'ts	14.0	4.7	47.1	100
8	165/7/8/9 Sec. Contm'ts	10.0	3.3	28.8	100
9	165/7/8/9 Sec. Contm'ts	8.7	2.7	22.8	100
10	165/7/8/9 Sec. Contm'ts	14.7	2.0	50.3	100
11	165/7/8/9 Sec. Contm'ts	27.3	3.3	108.1	100
12	165/7/8/9 Sec. Contm'ts	14.7	3.3	50.3	100
13	165/7/8/9 Sec. Contm'ts	16.7	3.3	59.5	100
14	165/7/8/9 Sec. Contm'ts	11.3	3.3	34.7	100
15	165/7/8/9 Sec. Contm'ts	16.0	6.7	56.3	100
2 QC	165/7/8/9 Sec. Contm'ts	37.3	4.2	156.6	100
11 QC	165/7/8/9 Sec. Contm'ts	29.3	4.3	138.9	100



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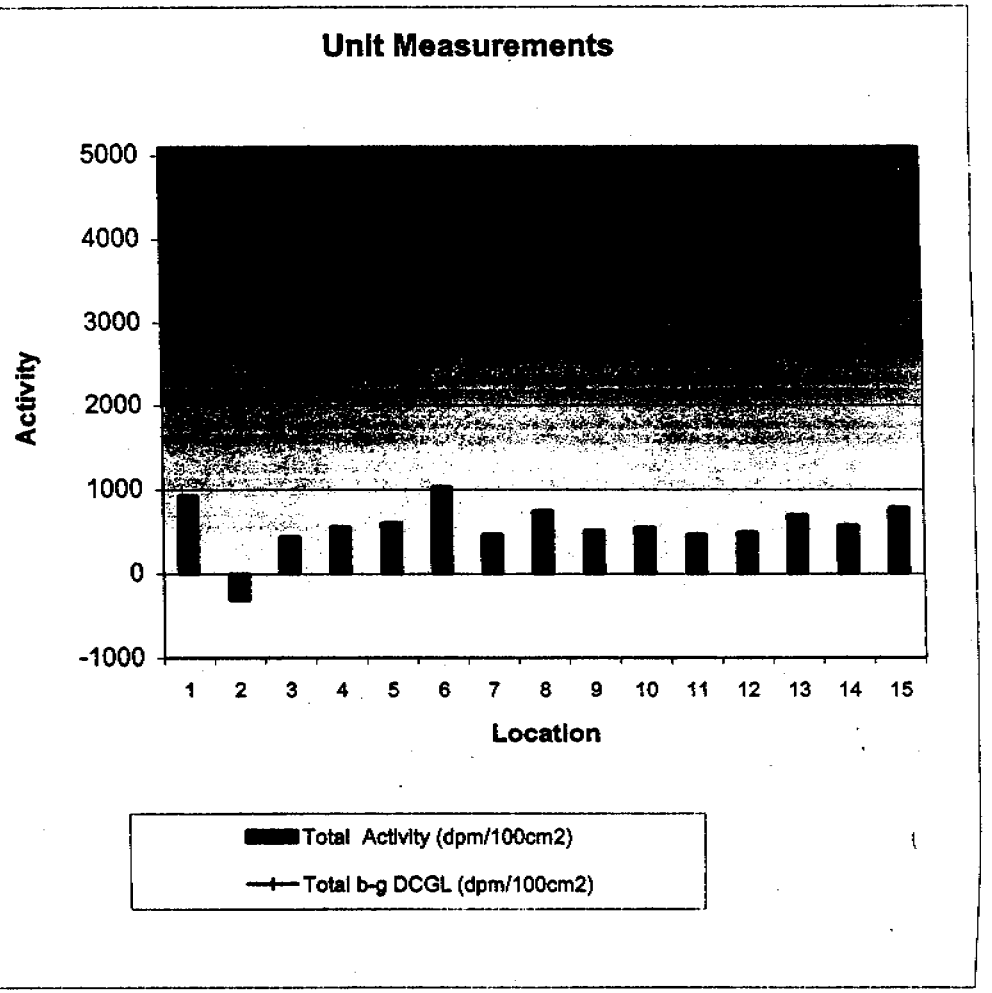
Total TSA Beta-Gamma

371005

8/25/01

				Instrument	1526	1380
standard deviation:	300.6	max:	1038.4	Ave. Instrument background:	547.5 cpm	499.1 cpm
mean:	573.3	min:	-304.9	Instrument efficiency:	29.8%	33.5%
median:	560.8			Instrument MDA:	318 dpm	318 dpm

	Surface Location	Total Counts (cpm/100cm²)	Local Area Bkgd (cpm/100cm²)	Total Activity (dpm/100cm²)	Total β–γ DCGL (dpm/100cm²)
1	165/7/8/9 Sec. Contm'ts	810.0	553.0	928.0	5000
2	165/7/8/9 Sec. Contm'ts	397.0	405.0	-304.9	5000
3	165/7/8/9 Sec. Contm'ts	647.0	460.0	441.4	5000
4	165/7/8/9 Sec. Contm'ts	687.0	476.0	560.8	5000
5	165/7/8/9 Sec. Contm'ts	704.0	486.0	611.5	5000
6	165/7/8/9 Sec. Contm'ts	847.0	576.0	1038.4	5000
7	165/7/8/9 Sec. Contm'ts	655.0	447.0	465.3	5000
8	165/7/8/9 Sec. Contm'ts	752.0	631.0	754.8	5000
9	165/7/8/9 Sec. Contm'ts	672.0	457.0	516.0	5000
10	165/7/8/9 Sec. Contm'ts	684.0	485.0	551.8	5000
11	165/7/8/9 Sec. Contm'ts	655.0	459.0	465.3	5000
12	165/7/8/9 Sec. Contm'ts	664.0	506.0	492.1	5000
13	165/7/8/9 Sec. Contm'ts	736.0	449.0	707.1	5000
14	165/7/8/9 Sec. Contm'ts	693.0	503.0	578.7	5000
15	165/7/8/9 Sec. Contm'ts	765.0	594.0	793.6	5000
2 QC	165/7/8/9 Sec. Contm'ts	482.0	500.0	-219.8	5000
11 QC	165/7/8/9 Sec. Contm'ts	845.0	595.0	998.3	5000



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Removable Activity - Alpha

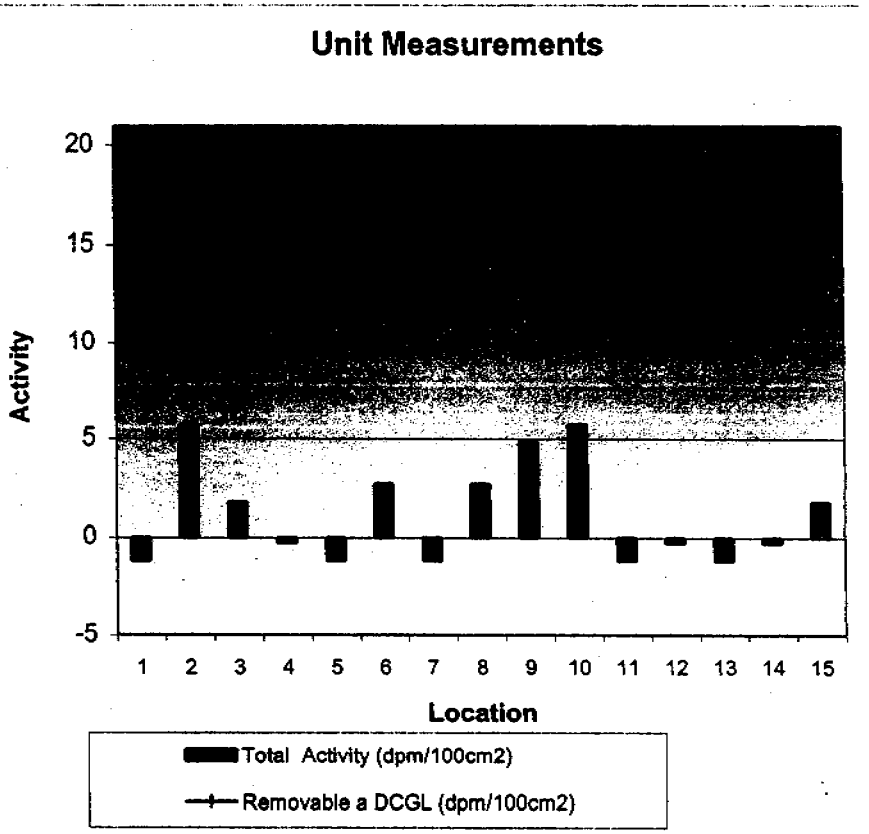
371005

8/25/01

standard deviation:	2.6	max:	5.8
mean:	1.2	min:	-1.2
median:	-0.3		

Instrument:	1428	1430
Instrument background:	0.4 cpm	0.1 cpm
Instrument efficiency:	33.0%	33.0%
Instrument MDA:	10 dpm	10 dpm

	Surface Location	Total Counts (cpm/100cm²)	Bkgd (cpm/100cm²)	Total Activity (dpm/100cm²)	Removable α DCGL (dpm/100cm²)
1	165/7/8/9 Sec. Contm'ts	0.0	0.4	-1.2	20
2	165/7/8/9 Sec. Contm'ts	2.0	0.1	5.8	20
3	165/7/8/9 Sec. Contm'ts	1.0	0.4	1.8	20
4	165/7/8/9 Sec. Contm'ts	0.0	0.1	-0.3	20
5	165/7/8/9 Sec. Contm'ts	0.0	0.4	-1.2	20
6	165/7/8/9 Sec. Contm'ts	1.0	0.1	2.7	20
7	165/7/8/9 Sec. Contm'ts	0.0	0.4	-1.2	20
8	165/7/8/9 Sec. Contm'ts	1.0	0.1	2.7	20
9	165/7/8/9 Sec. Contm'ts	2.0	0.4	4.8	20
10	165/7/8/9 Sec. Contm'ts	2.0	0.1	5.8	20
11	165/7/8/9 Sec. Contm'ts	0.0	0.4	-1.2	20
12	165/7/8/9 Sec. Contm'ts	0.0	0.1	-0.3	20
13	165/7/8/9 Sec. Contm'ts	0.0	0.4	-1.2	20
14	165/7/8/9 Sec. Contm'ts	0.0	0.1	-0.3	20
15	165/7/8/9 Sec. Contm'ts	1.0	0.4	1.8	20



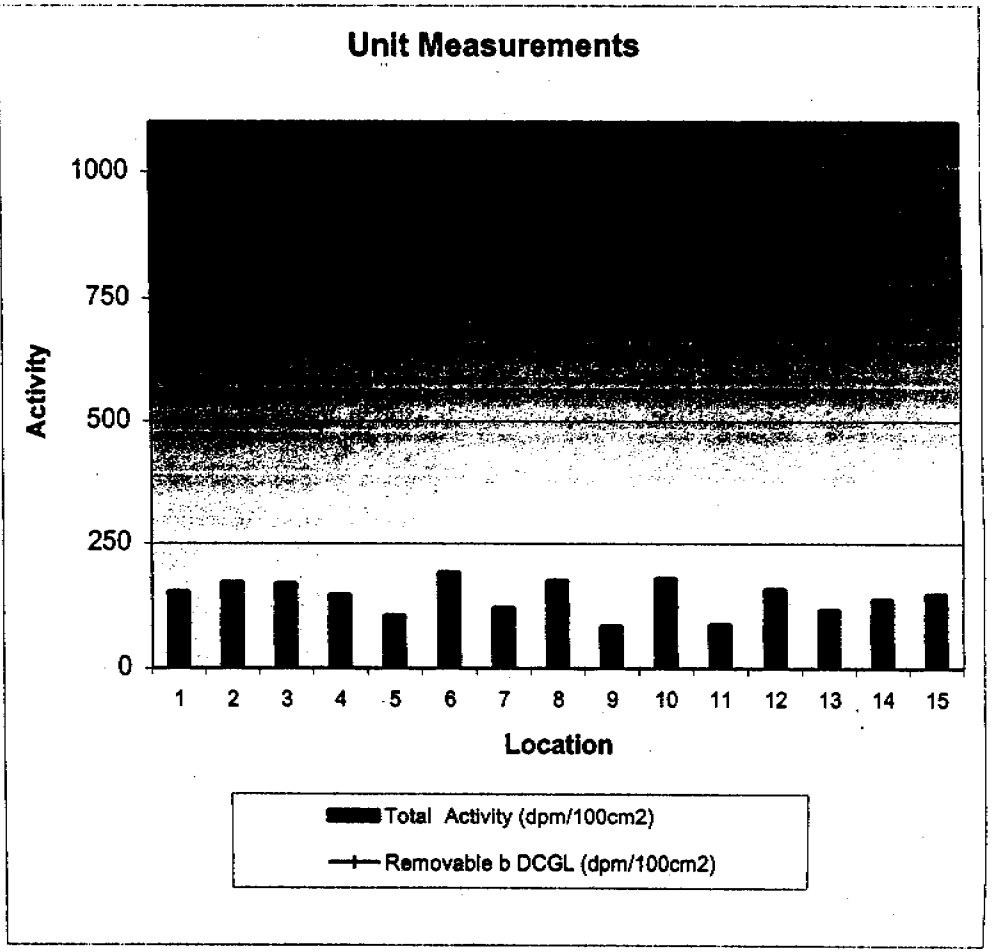
Removable Activity - Beta-Gamma

371005

8/25/01

				Instrument:	960	872
standard deviation:	33.2	max:	191.2	Instrument background:	30.7 cpm	33.2 cpm
mean:	143.5	min:	85.2	Instrument efficiency:	25.0%	25.0%
median:	149.2			Instrument MDA:	200 dpm	200 dpm

	Surface Location	Total Counts (cpm/100cm²)	Bkgd (cpm/100cm²)	Total Activity (dpm/100cm²)	Removable β DCGL (dpm/100cm²)
1	165/7/8/9 Sec. Contm'ts	69.0	30.7	153.2	1000
2	165/7/8/9 Sec. Contm'ts	76.0	33.2	171.2	1000
3	165/7/8/9 Sec. Contm'ts	73.0	30.7	169.2	1000
4	165/7/8/9 Sec. Contm'ts	70.0	33.2	147.2	1000
5	165/7/8/9 Sec. Contm'ts	57.0	30.7	105.2	1000
6	165/7/8/9 Sec. Contm'ts	81.0	33.2	191.2	1000
7	165/7/8/9 Sec. Contm'ts	61.0	30.7	121.2	1000
8	165/7/8/9 Sec. Contm'ts	77.0	33.2	175.2	1000
9	165/7/8/9 Sec. Contm'ts	52.0	30.7	85.2	1000
10	165/7/8/9 Sec. Contm'ts	78.0	33.2	179.2	1000
11	165/7/8/9 Sec. Contm'ts	53.0	30.7	89.2	1000
12	165/7/8/9 Sec. Contm'ts	73.0	33.2	159.2	1000
13	165/7/8/9 Sec. Contm'ts	60.0	30.7	117.2	1000
14	165/7/8/9 Sec. Contm'ts	68.0	33.2	139.2	1000
15	165/7/8/9 Sec. Contm'ts	68.0	30.7	149.2	1000
16					
17					



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ATTACHMENT D

Data Quality Assessment (DQA) Details

DATA QUALITY ASSESSMENT (DQA) – 371 N. Side Demolition Project PDSR

INTRODUCTION

Data used in making management decisions for decommissioning and waste management must be of adequate quality to support decisions. Determination of adequate data quality is accomplished through the DQA. Adequate data quality for decision-making is required by the Kaiser-Hill Team Quality Assurance Program (K-H, 1997, §7.1.4 and 7.2.2), as well as by the customer (DOE, RFFO; Order 414.1A, Quality Assurance, §4.b.(2)(b)). Regulators and the public also expect decisions and data that are technically and legally defensible.

Verification and validation criteria, used for the DQA, are summarized in tabular format for radiological surveys in Tables D-1 and D-2. DQA checklists, by Survey Unit, for radiological survey data are maintained in each respective radiological Survey Package (taken from RSP 16.04).

This report will be submitted to the CERCLA Administrative Record for permanent storage within 30 days of approval by the Regulators. All radiological data are organized into Survey Packages, which correlate to unique (MARSSIM) Survey Units.

Consistent with EPA's G-4 DQO process, the radiological survey design was optimized by checking actual measurement results (acquired during pre-demolition surveys) against model output with original estimates. Use of actual survey (result) variances in the MARSSIM DQO model confirms that an adequate number of surveys were acquired. This DQA implements QA guidelines taken from the following MARSSIM sections:

- §4.9, Quality Control
- §8.2, Data Quality Assessment
- §9.0, Quality Assurance & Quality Control
- Appendix E, Assessment Phase of the Data Life Cycle
- Appendix N, Data Validation using Data Descriptors.

SUMMARY

The data presented in this report have been verified and validated relative to quality requirements and the project decisions as stated in the original DQOs; results are summarized in the associated tables.

Table D-1 V&V of Radiological Surveys

V&V CRITERIA, RADIOLGICAL SURVEYS			K-H RSP 16.00 Series MARSSIM (NUREG-1575)		
QUALITY REQUIREMENTS					
	Parameters		Measure	frequency	COMMENTS
ACCURACY	initial calibrations		90%<x<110%	≥1	multi-point calibration through the measurement range encountered in the field
	daily source checks		80%<x<120%	≥1	
	local area background	Field	<MDL	≥1	all local area backgrounds were within expected ranges (i.e., none anomalouosly high)
PRECISION	field duplicate measurements for TSA		results relative to MDA	≥10% of reals	imprecision within Survey Unit 371004 due to radon daughters, as concluded by Radiological Engineering
REPRESENTATIVENESS	MARSSIM gridding methodology		Statistical	NA	random w/ statistical confidence; locations with elevated alpha results were associated with detectable levels of naturally-occurring Uranium daughters, sp. Po-210, DOE-added radionuclides were not detected (see Table D-2)
	Survey Maps			NA	random survey measurement and scan locations documented to ±0.2ft
	Controlling Documents (Survey Packages; RSPs)		Qualitative	NA	
	Decay of radon progeny		Decay measurements < original measurements	On request	19 hr decay time. 7/8 decay measurements yielded lower valves than original measurements, as expected with short-lived radon daughters.
COMPARABILITY	units of measure		dpm/100cm^2	NA	Use of standardized engineering units in the reporting of measurement results
COMPLETENESS	Plan vs. Actual surveys usable results vs. unusable		>95% >95%	NA	
SENSITIVITY	detection limits		TSA: ≤50 dpm/100cm^2 RA: ≤10 dpm/100cm^2	all measures	MDAs ≤ ½ DCGLw per MARSSIM guidelines

Table D-2. Survey Completeness Summary – Building 371 North Side Demolition Project

ANALYTE/ LOCATION	# Samples Required (incl. Media; Real & QC Samples)	# Taken (Real & QC Samples)[B]	Project Decisions (Conclusions) & Uncertainty	Comments (RIN, Analytical Method, Qualifications, etc.)
Radiological Surveys • Survey Unit: 371002	15 TSA & 15 Smears (random) 2 QC TSA 3% Scan	Same Plus 1 pair of decay measurements	>95% confidence, no contamination present	TSA exceeded $DCGL_w$.
• Survey Unit: 371003	15 TSA & 15 Smears (random) 2 QC TSA 3% Scan	Same	As above	TSAs < $DCGL_w$, and scans < investigative level.
• Survey Unit 371004	15 TSA & 15 Smears (random) 2 QC TSA 3% Scan	Same Plus 2 pairs of decay measurements	As above	TSA exceeded $DCGL_w$, and scan exceeded investigative level. One location (371004-scan) was radiologically depleted by sampling.
• Survey Unit 371005	15 TSA & 15 Smears (random) 2 QC TSA 3% Scan	Same Plus 2 pairs of decay measurements	As above	TSA exceeded $DCGL_w$. One location (371005-11) was radiologically depleted by sampling. Location 371005-02a did not show decay.